Honoring a Global Pillar of Noise Control Engineering

William W. Lang

A booklet based on a memorial session at INTER-NOISE 2018

Honoring a Global Pillar of Noise Control Engineering

William W. Lang

Based on the William Lang Memorial Session held during INTER-NOISE 2018
Chicago, Illinois on August 26, 2018

Robert J. Bernhard, Session Organizer
University of Notre Dame

Tamar Nordenberg, Rapporteur
VieCommunications.com

Edited by

Robert D. Hellweg
Hellweg Acoustics

George C. Maling, Jr.
Member, NAE

Eric W. Wood
Acentech Incorporated

Generous support for this booklet was provided by the INCE Foundation

Printed in the United States of America

2019

This booklet is posted on the INCE-USA website, http://www.inceusa.org

William W. Lang

Throughout his career, William (Bill) W. Lang was recognized for his contributions to noise control engineering. He encouraged others to become engaged, and was a mentor to many in the field.

He studied physics and received BS and PhD degrees from Iowa State University in 1946 and 1958, respectively, and an MS from MIT in 1949.

Bill joined the U.S. Navy and served from 1944 to 1947. He continued to serve in the Naval Reserve and was promoted to the rank of captain in 1968. Early in his career, he was employed by Bolt Beranek and Newman (as the firm's second employee) and by DuPont. He also taught at the U.S. Naval Postgraduate School in California. In 1958, Bill joined IBM to build an acoustics laboratory in Poughkeepsie and develop a noise control program for the company. While working in acoustics, he realized in the late 1980s that IBM could benefit from a conduit between IBM management and high-level engineers in all areas of technology. He pushed his idea to create the IBM Academy of Technology which today boasts about 800 members from 40 countries. He retired in 1992 as a member of the senior technical staff.

Bill was a leader in the development of American and international standards for the uniform and practical measurement of product noise. He organized and co-organized many professional conferences and workshops worldwide for the dissemination of information on noise control engineering.

He was a Distinguished Noise Control Engineer, Fellow, and past president of the Institute of Noise Control Engineering in the United States (INCE-USA). He was a founder and past president of the International Institute of Noise Control Engineering (I-INCE). He was an honorary Fellow of the Institute of Acoustics (UK) and the National Council of Acoustical Consultants, and a Fellow of the Audio Engineering Society (AES), American Association for the Advancement of Science, and the Institute of Electrical and Electronics Engineers. He was a Fellow, recipient of the Silver Medal in Noise, and past treasurer of the Acoustical Society of America. He was a registered professional engineer in New York State.

The achievement he was proudest of was his election to the National Academy of Engineering in 1978. He was cited for "Contributions and leadership in the field of noise control engineering." In 2004, he worked with NAE management to develop an initiative in noise control engineering. A scoping workshop was held in 2005, and the program led to the publication of the *Technology for a Quieter America* report published by the National Academies Press in 2010. Bill co-organized a follow-on Technology for a Quieter America program that created workshops hosted by the NAE and workshop reports, which are available in PDF format from the INCE-USA website. The subjects of these workshops were motorcycle noise, protecting national park soundscapes, cost-benefit analysis of noise barriers and quieter pavements, occupational noise, progress in product noise reduction, and engineering technology transfer.

Bill attended a follow-on workshop hosted by the NAE in Washington, D.C., on October 11–12, 2016. After his passing, two additional workshops were held—one in May 2017 on commercial aviation noise and the second in December 2018 on noise from unmanned aerial vehicles (drones).

CONTENTS

1	INTRODUCTION	1
2	PRESENTATION SUMMARIES	
2.1	**Bill Lang's Contributions at the National Academy of Engineering** C. D. (Dan) Mote, Jr.	3
2.2	**Bill Lang—Family and Personal Perspectives** Robert Lang	5
2.3	**Bill Lang's Innovative Approaches in the Founding of Professional Organizations** George Maling	21
2.4	**Bill Lang's Contributions to IBM Acoustics and IBM in General (Pt 1)** Matthew Nobile	27
2.5	**Bill Lang's Contributions to IBM Acoustics and IBM in General (Pt 2)** David Yeager	37
2.6	**Bill Lang's Contributions to Acoustic and Noise Standards** Robert Hellweg	45
2.7	**Bill Lang: Technology for a Quieter America and Follow-on Workshops** Eric Wood	51
2.8	**Bill Lang and Global Noise Policy** Tor Kihlman	57
2.9	**Bill Lang's Contributions to Noise Control Engineering in Japan** Hideki Tachibana	61
2.10	**Bill Lang and I-INCE** Robert Bernhard	65
2.11	**Bill Lang's Contributions in Noise Control—Additional Audience Remarks** David Lubman and Truls Gjestland	71
2.12	**Bill Lang and Friends at Conferences** Francis Kirschner	73
2.13	**My Association with Bill Lang for More Than 40 Years** Janet Moss	77
APPENDIX		
	Bill Lang and the International Institute of Noise Control Engineering Robert J. Bernhard	A 1

1

INTRODUCTION

This booklet summarizes presentations made during a special memorial session honoring William W. Lang at the 2018 INTER-NOISE Congress in Chicago. The memorial session, held the afternoon of August 28, 2018, was organized by Robert Bernhard of the University of Notre Dame. Ten friends and colleagues made formal presentations, and two people from the audience made informal remarks. All remarks are summarized here, along with two people's contributions received after the special session, and a copy of a paper by Robert Bernhard titled "Bill Lang and the International Institute of Noise Control Engineering."

Contributors to the memorial session and this booklet include:

- C.D. (Dan) Mote, Jr. *President, National Academy of Engineering*
- Robert Lang, *son of Bill Lang*
- George Maling, *Member, National Academy of Engineering, and Board of Directors, INCE Foundation*
- Matthew Nobile, *Principal, Hudson Valley Acoustics*
- David Yeager, *Motorola Solutions Acoustic Technology Center, INCE-USA Fellow*
- Robert Hellweg, *Hellweg Acoustics and Treasurer, INCE Foundation*
- Eric Wood, *Principal, Acentech Inc., and President, INCE Foundation*
- Tor Kihlman, *Professor Emeritus, Applied Acoustics, Chalmers University of Technology*
- Hideki Tachibana, *Professor Emeritus, Applied Acoustic Engineering, University of Tokyo*
- Robert Bernhard, *Vice President for Research, University of Notre Dame, and Board of Directors, INCE Foundation*
- David Lubman, *DL Acoustics and Member, INCE and ASA*
- Truls Gjestland, *SINTEF, Norway*
- Francis Kirschner, *retired colleague*
- Janet Moss, *great friend for more than 40 years*
- Tamar Nordenberg, *professional science writer, VieCommunications Inc.*

In Figure 1-1, friends and colleagues offer a toast to Bill at the conclusion of the memorial session.

Figure 1-1 *A toast to Bill at the conclusion of the memorial session at INTER-NOISE 2018*

2

PRESENTATION SUMMARIES

2.1 Bill Lang's Contributions at the National Academy of Engineering

C.D. (Dan) Mote, Jr.—President, National Academy of Engineering

I'm thankful to be able to share some thoughts about Bill Lang's extraordinary actions and leadership in the field of noise control engineering, his lifelong passion. Bill was a generous financial contributor to the NAE, making possible the development and publication of the NAE consensus report titled *Technology for a Quieter America*, (TQA), in 2010. Bill also conceived a series of workshops and reports to address topics covered in the TQA report.

Bill and I had many discussions about the role of the NAE, along with the Academies of Sciences and Medicine. He was as passionate as anyone I have known about the importance of member participation in the work of the academy. In 2014 he prepared a report for me he titled *Unleashing the Intellectual Brilliance of the National Academies*. His vision in that report: to have the three national academies operate as a single influential academy, offering its members new opportunities to serve the immediate and long-term needs of the nation. He felt increasing collaborative member participation in the work of the academies was essential to avoid stagnation from failure to keep up with the rapidly changing modern world.

As a result, the three academies now work together closely, and the NAE Council also created the opportunity for member-initiated programs that advance the NAE mission and objectives. Six workshops have been developed under the new policy, which was announced in October 2016 when Bill was in the hospital, a few days before his passing. He would have been very pleased and proud to know that his ideas and initiatives led to these changes in how the NAE engages its members and other academies.

Bill Lang was an extraordinary man, a great contributor, and a first-class person. It was my true privilege to know him.

Note: *Bill worked often with Proctor Reid, director of the National Academy of Engineering Program Office and an NAE lead on the Technology for a Quieter America Project. Proctor expressed enthusiasm about participating in the tribute to Bill in Chicago, but sadly passed away not long before the memorial session was held. NAE President C.D. (Dan) Mote, Jr., presented his remarks in tribute to Bill via an audio recording.*

2.2 Bill Lang—Family and Personal Perspectives

Robert W. Lang—Bill's Son, IBM

I'm Bob Lang, Bill Lang's son. I'm going to call him "Dad" because that's how I knew him for 57 years.

This is how some of you probably remember my dad (Figures 2.2-1, 2.2-2). I'm not sure how many times he was up here at a podium at noise conferences, but it was a lot. And he was comfortable in front of a microphone. Every Monday morning he went to a Toastmasters club that he started in order to improve the ability of engineers to do public speaking. I can't say the same is true for me. I can count the number of times I've been in front of a microphone on one hand. And right now I can feel how important that skill is. This is going to be a challenging talk for me because I don't know much about noise control, and you can't talk about my dad without talking about noise control. And I'm in a room full of noise control engineers. So I'll do my best, without Toastmasters training in public speaking.

First, I want to wish George Maling a speedy recovery. George was my dad's longest and closest friend, colleague, and mentor. I did talk to Norah over the weekend, and George is doing much better, but he wasn't ready to travel.

I want to thank Bob Bernard and Bob Hellweg, Eric, Matt, Dan, Dave, Tor, and Professor Tachibana for organizing this tribute.

I don't need to tell you that my dad's sole passion was noise control. The talks to follow are going to describe his noise control contributions much better than I can. I hope to give you a different perspective of Dad. What I can tell you about noise control is that's the subject of the books, the journals, the papers that overfilled his bookcases and spilled out onto the desks, the tables, the chairs. Any unoccupied horizontal surface soon got covered. When that ran out, he stacked these items on the floor. After a few avalanches of papers, I would joke with him, "Maybe I should get a shovel and clear a path to your desk."

And I will admit that I was not a believer. My discussions with Dad would always go something like this: "No one has ever died from noise pollution. I can solve your noise pollution in two seconds." I would put on hearing protection earmuffs, and say "Noise problem solved, now let's solve some real pollution problems that are killing the planet, like the pollution of the air, water, and soil."

It's ironic that we learn more about a person after they're gone. We try to fill the emptiness by grasping at everything they've left behind. We yearn to understand their passion. As I went through the mountains of correspondence and papers and journals and books, I've come around a little. I realize that, yes, these earmuffs solve my current noise problem. But, when I wear them, I have a communication problem—I can't hear anything! I can't communicate with anyone, which is fine when you are mowing the lawn, but not so fine when you're trying to work with other people.

Humans are social creatures. We communicate; we collaborate; we innovate. We work together to solve problems and overcome obstacles. You can't do that if there's noise blocking

your communication. So I can see that my solution is like burying my head in the sand. It would be like putting a mask on my face to solve air pollution, or filtering my dirty drinking water. It doesn't solve the source of the problem. So I'm starting to get it.

Dad's whole life was acoustics and reducing sources of noise, and it's also the reason I exist, as you'll understand later. So I always wondered how Dad got started in noise control and acoustics. For that, we have to go back 75 years.

Dad graduated from Noble and Greenough School, basically a prep school for Harvard, in 1943. But Dad was a bit of a maverick, who had no desire to go to Harvard and enrolled at MIT. World War II was raging, and colleges had accelerated schedules. So Dad was able to finish his sophomore year by the end of 1944. When he turned 18, he enlisted in the Navy, went to radio tech school, and became a sonar operator on the USS Duluth, which is a destroyer escort. This was his first introduction to acoustics, and that's where he got hooked (Figure 2.2-3).

He was released from active duty in 1947, and he returned to MIT to study acoustics in the physics department. It was there that he met and became close friends with Uno Ingard. In 1949, Dad finished his masters in acoustics and went to work for a tiny architectural-acoustical firm in Cambridge, Bolt Beranek and Newman (BBN). At that point, the firm was actually only Bolt and Beranek when Dad was hired by Leo Beranek as his second employee.

I would like to insert a short sidebar here because I wasn't familiar with BBN at all, and what I found was fascinating. People know BBN for its acoustical consulting roots. The company designed the acoustics of the United Nations Assembly Hall in New York (and there's actually a funny story about my dad that involved a GenRad octave band analyzer falling on the floor of New York's Grand Central Station when he was on the way to make some measurements). BBN was also famous for analyzing audio tapes of the JFK assassination and the 18 missing Watergate minutes. But I found it most fascinating to learn about all the *other* things BBN—fondly known as the "third university of Cambridge"—did.

Fast-forward 20 years, and DARPA, which was looking to connect its computers in different parts of the country, contracted with BBN to build the first routers for an experimental computer network. In 1969 ARPANET was up and running, and they added more computers to it. And they added more computers. And I think you know where this is going. BBN was involved in developing e-mail to send messages between these computers on the network. BBN.com is the second oldest domain name on the internet. In 2013, Leo Beranek was recognized for these world-changing contributions and awarded the National Medal of Technology and Innovation by President Obama. Now, by no means do I claim Dad had anything to do with developing the internet—in fact, I always struggled with him through his networking and e-mail problems—but I did find it fascinating that he worked with some of these people on acoustics and noise issues and how some of the biggest innovations in the modern world were so closely related to noise control. And, while Dad didn't stay long at BBN, he remained a lifelong colleague of Dick Bolt and Leo Beranek.

To return to Dad's experience with the Navy, although he was released from active duty in 1947, he was still active in the Naval Reserve. In 1951 he was offered a position as a physics instructor at the new Naval postgraduate school in Monterey, California, and he jumped at that opportunity. But, of course, he still was involved with acoustics; he was a member of the Acoustical Society of America (ASA).

When Uno Ingard was going to be honored in 1954 with the Bruce Lindsay Biennial Award at the 25th anniversary ASA meeting (Figure 2.2-4), Dad had to go. This turned out to be a pretty important meeting for Dad because Uno's sister, Asta, came all the way from Sweden

(Figure 2.2-5). That was a big deal in those days. You didn't just get on a jet and six hours later you were there. You took a boat, and it took a week. When my dad met her, it was love at first sight. He didn't want her to go back to Sweden, and two months later—*two months later*—they were married (Figure 2.2-6). Even today that would raise some eyebrows. You can imagine that it did in 1954. For their almost 50 years together, they were the happiest couple I knew (Figure 2.2-7).

In 1958, my dad finished his PhD in acoustics and was hired by IBM to start a noise control program for computers and build an acoustics lab (Figure 2.2-8). In 1959, I was born. And now you can understand why acoustics is the reason I'm here. By 1960, Dad had a home and was a well-established acoustical engineer working in noise control at IBM. You might think the story would go: he worked at IBM for 34 years, retired, and lived happily ever after. But that was just the beginning. Dad never stopped his quest for learning.

He taught himself Swedish, and was quite proficient in reading, writing, and speaking it. Every summer we would visit my mom's relatives in Sweden, and Dad would also make many friends and meet new colleagues in acoustics and noise control. Almost a quarter-century after he graduated from college, Dad spent a year preparing and then took both parts of the professional engineering exam because of his involvement with the newly formed Institute of Noise Control Engineering.

He was also fascinated with medicine. He was contemplating taking the medical school entrance exam, but he couldn't figure out how he was going to be able to use all this new knowledge in noise control. So instead, he just took courses in topics that interested him—like cellular biology, genetics, and nutrition, which was the reason he became a vegan. He would be very proud, but didn't get to know, that my son, Olaf, was admitted to medical school.

Dad tried to spread his enthusiasm for learning inside IBM by initiating a technical vitality program and the IBM Academy of Technology, which was modeled after the National Academy of Engineering. But it was really outside IBM that Dad made many of his most significant contributions, and you'll hear about many of them shortly. Dad's filing cabinet is full of more plaques and certificates in acoustics and noise control than I can count. I still can't imagine how he had time for all the outside organizations he belonged to. There was the National Academy of Engineering, INCE-USA, International INCE, INCE Foundation, Noise Control Foundation, the Acoustical Society of America, the Physical Society, the Audio Engineering Society, the IEEE, the American Association for the Advancement of Science, the U.S. Naval Institute, the Military Officers Association, Rotary, Toastmasters, the MIT Educational Council, the National Research Council, the American National Standards Institute, the International Electric Technical Commission, and the International Standards Organization. He was also an adjunct professor of physics at Vassar College. He sang every week in the church choir. And I'm sure I missed something, but just reading the list is exhausting.

For obvious reasons, Dad was a master of time management. And he absolutely hated wasting time, which is what he considered TV to be. In 1968, I found a quote from him in the Noble and Greenough 25th reunion book: "I watched TV once and found it the biggest waste of time and won't do that again." In 1969, we did finally get a TV to watch the moon landing—because that was a once-in-a-lifetime scientific and engineering milestone.

Next, I want to talk about what I consider Dad's most significant accomplishment, which I'm sure many of you know about, but it was new to me. And I only learned about it going through papers after he died. I joined IBM in 1982 to work in a lab where I had interned while I was in school. It had nothing to do with acoustics, and the only connection to Dad's group was it

was the same company in Poughkeepsie. One of my first jobs was characterizing fiber optic cable. We would use a laser pulse dispersion technique and, to calculate the bandwidth, we used a fast Fourier transform algorithm (FFT) to convert our digitized input and output time signals into the frequency domain. I told my dad what I was working on and asked him if he knew anything about the FFT.

He said he knew a little, which I realize now was an understatement. He said he knew Jim Cooley. I was amazed. I had read Jim's name in the footnote on the algorithm we were using. I said, "You know Jim Cooley?" "Yeah. He works at IBM in Yorktown." And that was it. Nothing about the fact that Dad was the chair of the IEEE working group on audio and electroacoustics in 1967 where information on the FFT was published in its transactions. Nothing about the fact that he wrote a paper with Jim Cooley.

Dad decided they should have a dedicated workshop on FFT. That workshop was at Arden House. I was there when I was 8 years old. I thought Arden House was a nice hotel at the top of a mountain with beautiful views, wildlife, and hiking paths. I didn't realize that what they were discussing inside would become the Woodstock of digital signal processing. Dad got a hundred of the top researchers together to exchange ideas about how to use the FFT. And the papers that were written were early in the development of this new algorithm.

How is it possible that he didn't tell me that he knew anything about this? Digital signal processing is one of the most important developments in my lifetime. It's one of the building blocks of digital communications. And it's used everywhere. It's in my cell phone. It enables digital photography. It's the data compression in my MP3 music files. It's the noise canceling in my Bose headphones so I can listen to my MP3 files when I'm on an airplane. It's the amazing image stabilization on the video on my GoPro, as I'm flying down a Rocky Mountain trail on my mountain bike. And it's the medical imaging that I need after I crash my mountain bike, if I get an MRI or CAT scan or ultrasound. Everyone takes all of these things that use digital signal processing for granted today.

Let's jump again to the Navy. Dad served for 35 years and was promoted to captain, which is one grade below admiral (Figures 2.2-9, 2.2-10). So he must have been doing something important, but I didn't know what it was. Dad was very proud to be in the Navy. "The Navy is the best of the best," he would say. "They have the Navy Seals, the Marines, and Navy pilots, who are the most skilled in the world." And he would say, "If anyone doubts that, they should try landing a jet going 300 feet per second, on a 300-foot runway in rough seas at night."

I never knew what Dad did in the Navy until now. And the key is the underwater sound. Radar is useless. Microwaves attenuate too rapidly. Sonar can detect submarines. So for all of submarine design—from the nose to the propeller, and for submarine detection—underwater acoustics is the most important subject. So I get it. He was working on signal analysis and digital signal processing to identify foreign submarines. The work was highly classified.

This is a picture from *The New York Times* that greatly affected my dad (Figure 2.2-11). He would read *The New York Times* cover to cover every day. So at the end of May 2016 was a milestone in his life because he stopped his subscription to the newspaper.

He said he was having trouble keeping up, and he was drowning in papers, which I can attest to. I tried to convince him to read it online, but he told me he had read *The Times* for 70 years in newspaper form and he just couldn't get used to reading it online. But he hardly missed a day. Even when he was away on his many trips, he would try to get the paper. And he would say, "Oh, the day is saved. I found *The New York Times*." Well, he only saved one copy, and that's this one dated April 23, 2016, and it shows Russian sailors walking toward two nuclear

submarines. And he said, “This is the scariest cover I've seen in decades.” He said that because he knew a little bit about our ability to detect them.

Dad had a top security clearance for his anti-submarine work, which makes the following even more amusing. After 9/11, Dad found himself on the no-fly terrorist list. He had a few choice words for what he thought about the competence of the newly formed TSA.

All they had to do was ask the Navy—he was on their roster as “Captain, USNR;” or check his Anti Submarine Warfare (ASW) security clearances; or they could check with the membership of the National Academy of Engineering. Instead, he spent hours on the phone, on hold, and all he could get was a redress number so he could go through special security whenever he flew. He finally got it cleared up, but it took years.

So what's it like living with a member of the National Academy of Engineering? Dad was an engineer to the core. He would write down everything. Everything was documented, recorded. There was literally a list for everything. The to-do lists: what to do in the morning to the end of the night; lists of exercises: the date, the reps, the weight; the list of groceries; a list of phone calls with time, date, duration; list of glasses of water he drank—time and quantity. There was a log-in for all the cars for gallons of gas, the date, the price, the miles per gallon.

One of the last things he was doing in his hospital bed was grasping at his gown. I thought he was trying to remove an EKG button, and I said, “You can't do that.” He said, “I'm trying to get my pen.” I said, “What do you need a pen for?” He said, “I have to make a list of all the nurses that are taking care of me so I can thank them.”

Like all good engineers, Dad would measure everything, and it had to be in SI units. When I was cooking with him, I'd say, “Add a dash of this.” He’d go, “What's a 'dash'? That's not a metric unit.” He had to measure everything in grams, milliliters, and know what temperature for how long so he could exactly replicate the recipe. Dad wanted everything quantified and documented.

And that brings us to instructions. Dad had a thing for instructions. You could not turn on even the simplest appliance without reading the instructions first—even if it was a toaster. I once purchased an all-in-one printer for him with a 232-page booklet, and he said, “This may take a while.”

I apologize if any of you have heard the following story, because Dad would often tell it. But I'm telling it again because it's so typical of my dad and my Uncle Uno. My dad was the typical engineer: neat hair, white shirt and tie, pocket protector. Uncle Uno was the exact opposite. He was the mad scientist: messed-up hair, wrinkled clothes that looked like he’d slept in them—because he probably had been up all night trying to solve a math problem. But they had a great time together (Figure 2.2-12).

Before I was around, they went camping. And this is the Uno-and-Bill-umbrella-tent-camping story. Because Dad always wanted to read instructions and Uncle Uno never read instructions, Dad says, “Aren't you going to read the instructions?” And Uncle Uno replied, “I mean, it's a tent. You don't think I can set up a tent?” You have two members of the National Academy of Engineering—both with PhDs in physics who can solve extremely complex mathematical problems—setting up an umbrella tent, which should be easy. So they pulled out all the poles and the stakes and ropes, and they got started. And an hour later they still didn't have anything that would stand up to provide shelter. Uno finally asked Dad, “What did you do with those instructions?” which he thought was funny. The upshot for me of the incident was: How many members of the National Academy of Engineering does it take to set up an umbrella tent?” Well, it could be “How many PhDs in physics?” or “How many members of INCE-USA?”

Dad liked the outdoors. He liked camping, and he liked skiing (Figure 2.2-13). I exist because of acoustics. My kids exist because Dad loved skiing and took me skiing. And skiing became a big part of my life. I met my wife on a ski slope. We got married on a ski slope. My younger son took skiing all the way to the World Cup. Thanks, Dad. Dad also liked the water. He liked sailing. He liked windsurfing, and waterskiing (Figures 2.2- 14, 2.2-15).

But back to noise control. Perhaps the reason I'm speaking here today at all is that on August 1, 1970, Dad laid out the flip charts on the floor of Leo Beranek's living room for his proposal for a professional organization that would certify qualified noise control engineers and inform the public on noise matters. The Institute of Noise Control Engineering was voted into existence on January 12, 1971, at a workshop at—where else?—Arden House.

Dad helped write the Noise Control Act of 1972. It was timely that Senator John Tunney, of California, announced he thought he had secured enough votes for passage of that bill at the banquet of the first-ever INTER-NOISE in October 1972, in Washington. So, you think, things are going pretty well for noise control in the '70s: There were new laws, there was a new professional society. But not everyone was on board. I saw a memo from Dad, dated January 26, 1971, where he wrote, "A major vacuum cleaner manufacturer built a very quiet model, but it didn't sell because people didn't trust a cleaner that didn't roar. People equate noise with power."

I think some of that is still true today. But I hope that Elon Musk can help squash some of that misconception since the Tesla Model S is the fastest production car on the planet, clocking 0 to 60 in 2.28 seconds, and it's also one of the quietest cars on the planet. In fact, electric cars are too quiet. They actually have a sound generator to make noise at low speeds to alert pedestrians because pedestrians are accustomed to cars making noise.

After Mom died in 2003, Dad took his passion for noise control to a new level. I think it was therapeutic for him. Through his association with the National Academy of Engineering, he started a program to study technology for a quieter America. And TQA was born.

You'll hear more about this shortly. In 2010 the NAE published the *Technology for a Quieter America* study, and every year since, there have been follow-up meetings. The last couple of years, the trip was becoming difficult for Dad, so I would drive him to Washington. He was happy to show me what he was working on even though I was a skeptic. In fact, we were just getting back from the meeting in 2016 when he had his stroke.

So now I want you to imagine something. I want you to imagine what the world would be like if we all had taken my approach, and there was no INCE, and there had been no noise control in the last 50 years. I think we'd all be wearing noise-reducing hearing protectors.

Dad once wrote a phrase in Swedish on his whiteboard: "Tack gud att idag ar jag fortfarande relevant i varlden." My Swedish is not very good. It means "Thank God today I'm still relevant to the world" (Figure 2.2-16). It's a message for life that we can all strive for: to find your passion, stay relevant, and contribute as long as you can. One of Dad's favorite presidents was Abe Lincoln—I think because he started the National Academy of Engineering. Lincoln once said "In the end, it's not the years in your life that count. It's the life in your years."

Dad packed a lot of life into his 90 years. He found his passion, and did it right to the end. I think he would agree with me saying he was in the right place at the right time with the right people to be part of some of the most significant engineering accomplishments ever. His contributions have made the world measurably quieter for everyone (Figure 2.2-17).

Figure 2.2-1 *Bill speaking at INTER-NOISE 1981*

Figure 2.2-2 *Bill at the microphone*

Figure 2.2-3 *A sonar operator on destroyer escort USS Duluth*

Figure 2.2-4 *Uno Ingard honored with an award*

Figure 2.2-5 *Asta Ingard*

Figure 2.2-6 *Bill and Asta wedding picture*

Figure 2.2-7 *Bill and Asta Lang together*

Figure 2.2-8 *IBM Acoustics Lab built by Bill. George Maling is on the left*

Figure 2.2-9 *Bill in Navy whites*

Figure 2.2-10 *Bill in Navy blues*

Figure 2.2-11 *Scary cover of the April 23, 2016, New York Times showing Russian sailors and two nuclear submarines*

Figure 2.2-12 *Bill and Uno enjoying time together*

Figure 2.2-13 *Bill enjoyed skiing*

Figure 2.2-14 *Wind surfing time*

Figure 2.2-15 *Water skiing time*

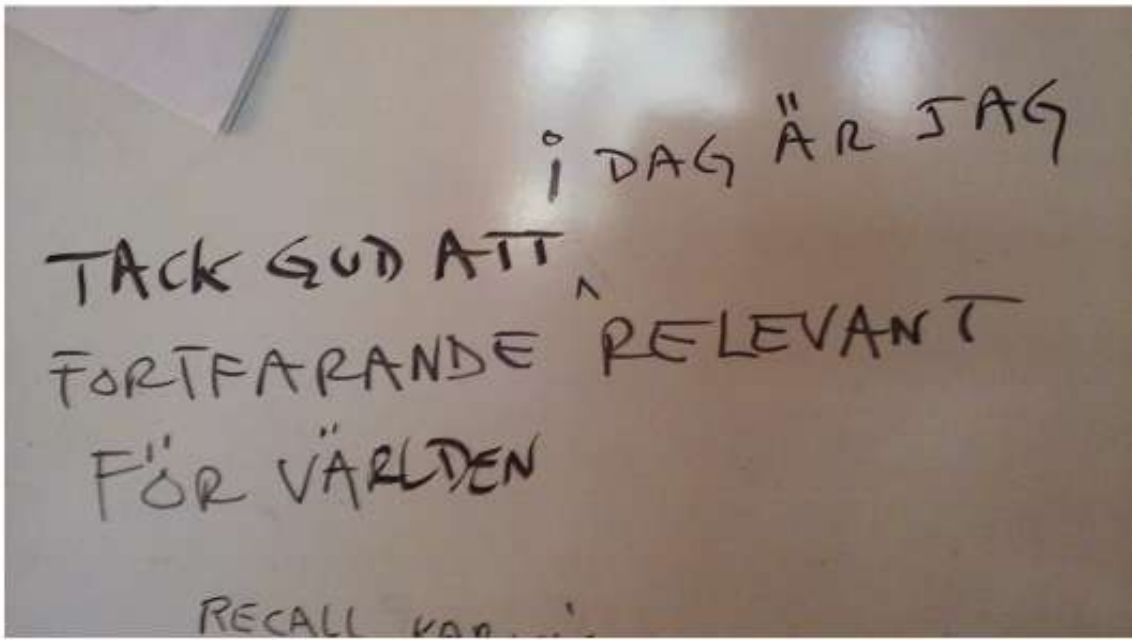


Figure 2.2-16 ‘‘*Thank God today I'm still relevant to the world*.’’

Figure 2.2-17 *A smile and a wave from Bill*

2.3 Bill Lang's Innovative Approaches in the Founding of Professional Organizations

George C. Maling, Jr.—Member, National Academy of Engineering,
and Board of Directors, INCE Foundation

Introduction

I am going to touch on several innovations that Bill made in support of our profession—mostly in the early days—from the first time I met and worked with him. From that time until his passing, we worked together for almost 60 years, so it was a long collaboration.

Before I met Bill, he had served in the U.S. Navy, taught at the U.S. Naval Postgraduate School, received his PhD, worked at Bolt Beranek and Newman (as their second employee), and worked at DuPont. So he was very experienced in acoustics and noise control.

In this tribute, I focus on *innovation* and the organizations that he founded. These include the IBM Acoustics Laboratory, the IEEE Signal Processing Society, INCE-USA, International INCE, the INCE Foundation, and the IBM Academy of Technology.

Bill Lang and IBM

I first met Bill in 1957, when we shared an office at MIT for a short time. About 18 years ago, I was sorting through old issues of the *Journal of the Acoustical Society of America*, and came across a 1957 issue that had an IBM advertisement on the back page (the journal took advertising in those days). IBM was looking for an experienced professional to start an acoustics and noise control program. I think Bill responded to that ad. Later, I learned that Thomas J. Watson Jr. himself had dictated a memo that in essence said: Our customers have recently been complaining about the noise of our products. I think we need an acoustics laboratory to solve some of these problems.

Bill joined IBM in 1958 in Poughkeepsie, New York, and set out to develop a noise control program. The first step was facilities. He designed and built an acoustics laboratory that consisted of an anechoic chamber that was convertible from fully anechoic to semi-anechoic. He also designed and built a reverberation room.

Noise emission standards are a key element in any machinery noise control program, and much of the early 1960s was spent in the development of internal IBM standards. Other IBM locations soon began to develop acoustical facilities, and Bill maintained some control through corporate assignments in both standards and technology. Eventually there were U.S. laboratories in Endicott, New York; Rochester, Minnesota; San Jose, California; Austin, Texas; and Boca Raton, Florida. There were also acoustics labs in Germany, Japan, Brazil, and elsewhere. Matt Nobile speaks more to Bill's work at IBM in his tribute.

Fast-forward to the late 1980s. IBM was having great difficulties with the product line. Microprocessor designs were on a very different price-performance curve than traditional mainframes, and the testing of very large integrated circuits had become very difficult. Bill regarded Poughkeepsie's problems (and those elsewhere in the company) as due to lack of inputs to management from its very large technical community and determined to do something about it.

His long relationship with the National Academy of Engineering led him to believe that IBM would benefit from the establishment of an internal Academy of Technology, and he set

about convincing upper management that such an academy was necessary. It was not easy! The Academy became a reality and Bill retired soon afterward, in 1992. As many know, IBM is currently reinventing itself and its product line through a new series of strategic initiatives. I asked Ginni Rometty, the current president, what role the Academy played in the establishment of these initiatives and quickly received a reply from John Kelly, a senior VP who oversees the Academy. He said "Yes, the Academy was very instrumental in driving our focus on our strategic initiatives. The Academy is doing quite well, and remains vital to IBM." This is a major tribute to one of Bill's innovative contributions to IBM. Dave Yeager speaks more about Bill's efforts and the IBM Academy.

Bill Lang, the FFT, and Signal Processing

I served as a consultant to IBM beginning in the late 1950s, and joined the IBM acoustics laboratory in 1965. One of our side projects was working with the IEEE, especially with the Technical Group on Audio and Electroacoustics, a group that started life as the IRE Professional Group on Audio. Leo Beranek was a key founder.

Bill became the chair of the Administrative Committee (ADCOM) and essentially saved the Group from extinction. The Group's publication, *Transactions on Audio and Electroacoustics*, was suffering from a lack of papers and a mission. Within a subcommittee of the Group, Bill led several persons from Bell Laboratories, MIT's Lincoln Laboratories, and others in the determination of power spectra.

Very soon, IBM's Jim Cooley came on the scene with the introduction (actually, reintroduction) of what became the fast Fourier transform (FFT) algorithm. Everyone involved recognized the algorithm as a major breakthrough in the machine computation of the Fourier series, and Bill led the effort to collect papers related to acoustics and signal processing for publication in the once-faltering *Transactions*. The June 1967 issue contained, among other articles, "What is the Fast Fourier Transform?" And an issue on digital filtering soon followed. The June 1967 issue became a classic document in the field. The Group had a new mission: signal processing.

One of the Group's members, Reg Kaenel, founded the International Conference on Speech and Signal Processing. The Group later became the IEEE Signal Processing Society, and its mission today is greatly expanded after Bill's innovative leadership in the 1960s.

In a history of the IEEE Signal Processing Society, Bill commented on the signal processing situation in the 1960s:

> "Signal processing was spread over various different areas within the now IEEE, and so there was no real home for this great development [the FFT] that was coming down the pike. In '66, the logical home for this would have been the Acoustical Society of America (ASA), which basically covers all aspects of the science of sound.
>
> We held a meeting in Boston as part of an ASA meeting. It was a special half day session, and was so popular that there were people—I can remember this—sitting on the floor in the meeting room. The meeting room was too small, and probably 150 people crammed into a space that would hold 100 comfortably. This was the first recognition that something that was really hot was coming. But the Acoustical Society was really not terribly interested, because this Society is basically an academic society. (It now has a Technical Committee on Signal Processing—Ed.)
>
> At that time the Group on Audio and Electroacoustics was struggling, and I mean struggling, because it inherited the background from the PGA (Professional Group on

Audio—Ed.). They didn't have much in the way of a publication, didn't have much of a program, and had no meeting of their own. The only meetings that they held were the IEEE international conventions which were usually held in New York once a year. The Group on Audio and Electroacoustics would sponsor a couple sessions at the international convention, and that was it. Well, it turned out that we had an opportunity to go to Arden House. You've gotten the story, I think, of the Arden House workshops (another series of workshops pre-INCE-USA!—Ed.). The Group on Audio and Electroacoustics sponsored the first and second, and I guess there was a third, workshops on Fast Fourier Transform and Signal Processing. It is well documented in the IEEE transactions. I wasn't the editor, and I wasn't directly responsible, but I think this is what saved the Group on Audio and Electroacoustics from disappearing. I think that it was so weak in the mid-'60s that when it took over from the PGA it really wasn't going to last very long.
—*William Lang oral-history interview, April 15, 1997, pp.* 5-7 (With minor editorial changes—Ed.)

I remember that ASA meeting very well. I was tasked with finding the shipment of papers for the signal processing session that had been delivered to the hotel. When I arrived at the back door of the meeting room and looked in, it was packed, as Bill noted. Fortunately, someone noticed me and opened the front door of the room. I slipped in, deposited the papers on a table, and sat on the floor to enjoy the session.

Bill Lang and INCE-USA

Leo Beranek and Bill were the drivers for the establishment of INCE-USA. By 1970, the EPA had already established the Office of Noise Abatement and Control (ONAC). Bill was concerned that an EPA regulatory program might bring out persons with little training in noise control. He and I went to Washington to discuss the issue with Al Meyer, the first director of ONAC. He encouraged us to develop some professionalism in the field.

There was, of course, activity in noise control in the 1950s and 1960s. Bill described those activities in an early history of INCE-USA. The first edition of the early history was published on the 20th anniversary of the founding of INCE-USA. Bill and Eric Wood collaborated on a second edition published in 2011. Leo Beranek gave a talk at the 40th anniversary of the founding of INCE-USA at NOISE-CON 2011 in Portland, Oregon, and explained the birth of INCE-USA as follows:

> "As many of you know, Dr. William Lang, then head of the acoustics department at IBM had the basic idea. In early 1970, Bill had already scheduled a 'Workshop on Noise Control Engineering' which was to be held in January 1971 at Arden House in Harriman, New York. He also thought about a possible society devoted to this subject, primarily because the Acoustical Society of America had discontinued the publication of *SOUND* (in 1962—Ed.) which was where practical papers on noise control appeared. Bill knew of my strong interest in the subject because of my successful noise reduction summer courses offered at MIT and he wanted to present his ideas to me. He came to Winchester, Massachusetts on August 1st, 1970, where we met in my living room.
>
> Let me tell you about Arden House where Bill had scheduled the meeting. This was originally the summer home of Averell Harriman who had been the 48th Governor of New York and who had also served in various positions under presidents Roosevelt,

Kennedy and Johnson. Arden House is located at the top of a mountain east of Harriman, New York. I remember driving to the meeting along plowed-out roads through Connecticut. After Harriman's death, Arden House passed through several hands and at the time of our meeting it was owned by Columbia University. Arden House commands extensive views of the Ramapo River Valley. On arrival, each of us was assigned a small bedroom. Meals were served in a dining area. A fairly sizeable auditorium had been added by Columbia for the purpose of meetings. We had the opportunity of being with our colleagues in a large lounge room.

In Winchester, where Bill and I met before Arden House, we agreed on the need for a Society devoted to noise and its control; on an archival publication on noise control, on a newsletter dealing with current noise matters, and on a possible procedure for noise control engineers to become accredited experts in the field. We planned presentations of these ideas at the Arden House conference.

We were gratified that 85 invited persons active in noise and its control were able to attend. Bill presented our ideas the first day. The next day I urged the following: **First,** INCE should be established with temporary management until an election could be held, **Second,** a credentials committee should develop criteria for membership in INCE, and **Third,** a journal to be called *Noise Control Engineering* should be planned.

The third day, these things were voted on, and the Institute of Noise Control Engineering was formally incorporated in the District of Columbia on June 11, 1971 with the IRS designation 501(c)(6)."

After Bill's initiative in 1970, we spent the rest of the year developing a list of attendees—persons we knew who had an interest in noise control—and started sending invitations. Bill developed the program for the meeting, which consisted of both technical presentations and a proposal for the establishment of a new organization, which Bill titled the Institute of Noise Control Engineering. I had some serious surgery in December 1970 and was unable to attend, but it has been reported that there was a lively discussion and in the end, as Leo said in his talk in 2011, those present voted to go ahead with the new organization.

The first half of 1971 was devoted to the preparation of articles of incorporation. Bill found a lawyer, and the organization was incorporated in the summer of that year. The first meeting of the interim board of directors was held in October. Bill served as executive director for many years, and as president in 1978. His leadership over many years made INCE-USA the vibrant organization it is today.

Why Bill Lang became a Registered Professional Engineer

As part of the organization of INCE-USA in the very beginning, none of the initial members became full members without an examination of their credentials and a contribution to professionalism in noise control engineering. Bill was chair of the board of examiners, and submitted his credentials. He was told that he could be "grandfathered" as a member of INCE-USA. Bill turned down the offer! He felt that, as chair of the INCE-USA board of examiners, he should have the proper credentials. So he did quite a bit of studying to take the engineer in training and professional exams. He passed, and then he could call himself a P.E.

The First INTER-NOISE

Sometime in 1971, Bill came into my office and said "INTER-NOISE." I asked "What's that?" He explained that he had been reading about an IEEE international conference on magnetics that

they called Inter-Mag. So that is how INTER-NOISE was first conceived. We decided to go ahead with the congress at the first meeting of the INCE-USA interim board mentioned above. As I have said before, that was a very risky decision. The organization had funds of less than $1,000 contributed by the interim board. We had no general chair, no proceedings editor, no secretariat, no exhibition manager, no hotel lined up, and little experience running a conference. Fortunately, Malcolm Crocker had run a noise conference at Purdue University in 1970, and he volunteered to be the general chair and proceedings editor.

From what we know now, no hotel would have accepted the risk of reserving meeting and sleeping rooms for us. Fortunately, the late Lewis Goodfriend had a good contact at the Shoreham hotel in Washington, and they agreed to work with us. Dan Flynn at the National Bureau of Standards (now NIST) agreed to act as the secretariat, and Jack Mowry agreed to organize the equipment exhibition. The meeting was a success, with about 1,200 persons attending, and INCE-USA had some start-up funds.

At the time, there was noise legislation pending in the Congress: two bills in the Senate and one in the House. Our lunch speaker at INTER-NOISE 72 was Bill Magruder, who was working in the White House at the time. Before lunch, Bill, Leo Beranek, and Ken Eldred asked Magruder for the White House position on the noise legislation. He made a quick phone call—to whom we don't know—and said President Nixon would support any bill. Magruder made the announcement at lunch. That caused a flurry of activity in Washington, and the Noise Control Act of 1972 was passed by both houses of Congress on the last day of the 92nd Congress.

Bill Lang and Noise Emission Standards

In 1970, Bill established a working group, WG 6, under ISO TC43 SC1-Noise to develop international standards. At its first meeting, there was a question about a metric for noise emissions. Those present said “sound power,” and that is how a set of international standards still used today began. Bob Hellweg speaks more in his tribute about standards and Bill's long service in support of those sound power standards.

Bill Lang and International INCE (I-INCE)

Bill knew Fritz Ingerslev (Technical University of Denmark) from his standards work. He also knew that Fritz was very much an anti-noise person. I believe he asked Fritz to organize the second INTER-NOISE at the Technical University of Denmark. Fritz agreed, and I am sure that the university gave him good support. But it has been rumored that Fritz had to raise funds privately (from himself!) to fund the meeting. Fortunately, the congress was a success, and INTER-NOISE was launched as a truly international event. After INTER-NOISE 73, Bill began thinking about future INTER-NOISE conferences to be held outside the U.S., especially in 1975 and 1977.

I wondered how long the series could go based on Bill's personal relationships with prospective chairs. (It turned out to be a long time!). We discussed the situation and concluded that an international organization was needed to select venues and chairs (now presidents) for the series. Bill communicated with Fritz Ingerslev, and evidently he agreed because International INCE was founded in 1974 with Fritz as president. Eric Rathé (Switzerland) became the secretary-general and he filed incorporation papers in Bern to establish the organization as a Swiss Verein. Bill continued with the organization of I-INCE while Fritz spent many hours corresponding with prospective member societies. Fritz relinquished the presidency and Bill became president in 1987. Bob Bernhard speaks much more about International INCE.

Bill and the INCE Foundation

Bill had served as treasurer of the Acoustical Society of America and was asked to establish a foundation as a charitable organization. Bill argued that, as a 501(c)(3) organization, a foundation was not needed, but ASA management asked him to proceed anyway. My point is that it was a learning experience.

INCE-USA, on the other hand, was founded as a 501(c)(6) organization (a business league) and would benefit by establishing a foundation to supplement its activities. Bill brought this to the INCE-USA board and received the go-ahead. Bill did the paperwork and worked through lawyers to obtain IRS approval to establish a 501(c)(3) organization. The INCE Foundation was founded in Williamsburg, Virginia, in 1983. INCE-USA gave the organization a start-up grant of about $74,000. Bill became president, and his wife, Asta, was the first treasurer. Bill was pleased to accept a major gift of $100,000 from the New York Community Trust to establish the Martin Hirschorn IAC Prize. Since then, the organization has grown and is flourishing under the current leadership of Eric Wood as president and Bob Hellweg as treasurer.

Bill's Personal Contributions to Me

In addition to the my work on IBM products, Bill gave me a lot of freedom at IBM to do things that I felt needed to be done in acoustics and noise control engineering. I will always be grateful for the experience.

In addition to all of the above innovations, Bill worked his way to captain in the U.S. Naval Reserve, and held weekly meetings in Poughkeepsie with his naval unit to discuss and make progress in signal analysis. At one time, I had a security clearance and Bill invited me to attend a classified conference related to signal analysis at the U.S. Naval Academy in Annapolis, Maryland. I was grateful to see another side of Bill, slim and trim, dressed in Navy whites.

Bill also had a concern about the ability of engineers to give speeches and presentations—not only in the acoustics laboratory, but in other areas of IBM Poughkeepsie. Determined to do something about it, he organized an IBM chapter of Toastmasters International and participated with chapter members every Monday morning at 7:00 a.m. His intent was that members prepare their speeches over the previous weekend and give them before work on Monday. No IBM time spent on Toastmasters!

Bill also had a “laugh of the day” at the IBM Acoustics Lab. He could always find some humor in a situation, and shared it with me and others. A little laugh created a spark of light in an otherwise intense and highly competitive environment.

Bill was also very supportive of my participation in professional activities—the Acoustical Society of America, INCE-USA, I-INCE, and the INCE Foundation. And he nominated me for Fellowship in several organizations. I am very grateful for that support.

Through his personal donations, Bill also taught me about philanthropy. He was a generous donor to the Rotary Foundation, his church, the NAE, the INCE Foundation, and I am sure, other organizations. It was the inspiration from his giving that led me to establish the Maling Family Charitable Fund as a donor-advised fund. While my level of giving can't be compared with Bill's, it has given me pleasure to support those nonprofit organizations I believe in. It was a pleasure working with Bill over almost 60 years. I hope he enjoyed it as much as I did.

2.4 Bill Lang's Contributions to IBM Acoustics and IBM Generally (Pt 1)

Matthew A. Nobile—Principal, Hudson Valley Acoustics

I'm Matt Nobile, and I'll be talking about Bill Lang's contributions to acoustics at IBM and to IBM in general. Dave Yeager will follow me with more on Bill's contributions while at IBM. I am honored to be here speaking at the memorial session for Bill Lang, with whom I worked closely at IBM for 10 years, until he retired in 1992, and then informally for about 24 additional years.

Bill would come by to my office after he retired, once a week at least, usually on his way to the Rotary. He would sit in my office for 15 to 20 minutes, and we'd just chat about all kinds of things. And those are the days I really miss. So, for this short talk, I'm just going to try to paint a broad picture of the many different things Bill took the lead on while at IBM. I'm sure you'll be impressed with the energy this man had. And, as I said, Dave will talk next about Bill and one of his signature accomplishments while at IBM.

First of all, here's the crew that was there for most of the time I worked with Bill, shown in Figure 2.4-1. Here's Bill in the middle, accepting a quality award. Here's George, of course, and Russ Wise, who sadly passed away last year. There's Dave Yeager—looks the same today. And I still haven't figured out who this hairy guy is back there!

Bill was very persuasive. And in 1959 he convinced IBM management that the new acoustics lab just had to be built in this beautiful wooded area, separated by a low hill away from the main, noisy site of IBM on Route 9, as shown in Figure 2.4-2. Well, it was an acoustics lab, right? It had to be quiet. And, thanks to Bill, we who have worked there have gotten to work in this beautiful setting. The original lab was a simple concrete building with a fully anechoic chamber that could be converted into a hemi-anechoic chamber, shown in Figure 2.4-3, so we could test IBM's brand-new line of mainframe computers.

The original building also contained the reverberation room shown in Figure 2.4-4. You can see in this photo what has to be the first rotating microphone boom constructed at IBM, using a floor turntable. In Figure 2.4-5, you can see the anechoic chamber in its fully-anechoic setup, with Bill testing one of IBM's quintessential tape drives. And this is to remind you of the kinds of products IBM made back then. Some of you will remember the very noisy IBM 1401 printer shown in Figure 2.4-6.

Over the years, the lab has modernized but basically looks the same at its site in Poughkeepsie, New York. In the 1983–84 time frame, shortly after Dave and I arrived at the lab, we added a large new wing with a hemi-anechoic chamber, with a special raised floor, shown in Figure 2.4-7, so we could test our new line of mainframe computers, which required cooling air from underneath to function. The key to all that was: Bill knew how to get things approved and get things done.

So let's look now at some of Bill's normal, day-to-day roles in his career at the IBM lab. We tend to forget that, not only did Bill do all these great things on standards and for INCE-USA, but he was a noise control engineer while at IBM. He wrote many IBM technical reports. Here are just a few of them, in Figures 2.4-8 and 2.4-9.

And, of course, he was presenting his work externally. For instance, this one from 1973—"Spatial and Temporal Distribution of Sound Pressure Levels in Data Processing Installation"—led to some experiments, way ahead of their time, by Russ Wise on scale

modeling of a data center using a spark source and a miniature microphone. This is shown in Figure 2.4-10. Yes, people were probably doing scale-model experiments back then, but I know no one in the computer industry was doing it. Bill Lang got these things going, too. And shown here in Figure 2.4-11 is an interesting report by Bill, from 1963, on the sound power from IBM equipment. There are companies today that are still not measuring sound-power levels of machines, and Bill was doing it back in 1963.

Bill was also an educator. He was a mentor to Dave, myself, and many more that came through the IBM acoustics lab. He taught and established courses and seminars for groups at INCE and other institutions, as well. And he was an adjunct professor at Vassar College, also in Poughkeepsie, during most of his time with IBM. Bill was a champion for technical vitality, preferring the term "professionalism." He encouraged all of us to get involved in external professional-society activities. He established the IBM-wide Authors Recognition Reward Program. In later years, he became the Poughkeepsie site Technical Vitality Chairman, thinking up ways to foster technical vitality among IBM engineers, not limited to acoustical engineers. One of his achievements in this area was starting an IBM technical vitality-focused publication, shown in Figure 2.4-12, called *Visions*. Bill believed that people who succeeded in professionalism would elevate their own stature as well as that of IBM's.

We also tend to forget that, for many years, Bill was a manager at IBM. And that carried with it all those fun manager-kinds-of-things that have to be done: financial, logistical, and personnel issues. Yep, once a year, Dave and George and I closed the door in Bill Lang's office (one-on-one!—Ed.) and sat there and endured a review of our progress for the year, and how we could improve for the next year. And Bill was pretty tough, believe me.

Bill's influence on IBM standards was just as enormous as his influence on external standards. And in many cases it's difficult to determine which came first, the internal IBM acoustic standard or the external standard. Bill was what was called the IBM Standards Project Authority, or SPA, for Acoustics. It was a high-end corporate position. It was really an enormous job because he had to deal not just with engineers but also with IBM division heads and vice presidents. The standards were not just measurement standards, but also defined noise limits for IBM products, so the various vice presidents across the divisions had a lot of turf to protect. So it wasn't easy: SPAs in IBM were the key interfaces with external standards organizations.

It's well known what Bill did with external standards, and we'll hear a little more from Bob on that. Just as an example, there was a 1969 IBM standard on determination of sound power levels of IBM machines. And this led to the external ANSI and ISO standards on sound power level measurements, all again thanks to the leadership of Bill Lang. The point: Even though IBM was a computer company, it was acoustics, under Bill Lang, that was a success story and model for the company-wide IBM corporate standards.

And what about Bill's achievements with IBM's interdivisional programs? IBM, back in the early days, had a lot of different and relatively independent divisions. And there weren't, of course, all these nifty internet tools for collaboration. So to exchange technical information among IBM engineers, face-to-face meetings had to be held, and projects had to be coordinated across the country and across the world.

The IBM program called the Interdivisional Technical Liaison program, ITL, was probably one of the most critical programs at IBM. And Bill was selected to chair that one for acoustics also. It was another corporate program. The emphasis was on technical information as opposed to the normal product development. The first ITL Acoustics Committee met in

Poughkeepsie in 1958 under Bill's leadership. And during the course of the ITLs, over 50 meetings were held until the program ended in 1992.

The bound hard-copy minutes, which are still in the IBM lab in Poughkeepsie, trace a long history of noise control engineering at IBM under Bill Lang's leadership. Just peeking at an agenda for a part of one of the ITL Acoustics meetings, with the many acoustics labs that had to be coordinated, you can get an idea of the scale of this effort Bill coordinated. There are 16 of them—16 fully functioning acoustics labs around the world, coordinated and led essentially by Bill Lang, listed in Figure 2.4-13. I'm tired just thinking about it all!

And, finally, let's look at Bill's role in IBM's critical and, I say, well-supported advanced technology programs. There were two main ones: The first was the so-called Group Technology Assignments, GTA. (IBM is famous for its acronyms.) The GTA program was established in 1967—and guess who was chosen to lead that one, too? Bill Lang. The goal was to conduct advanced technology programs. So Bill got all the acoustical specialists together around the world, and they identified a serious technology gap. Bill's solution: He identified 28 different technology areas in acoustics to go after. As a result of these efforts, from 1969 to 1981, the GTA program produced 99 different worldwide IBM advanced technology projects. The GTA program ended—and the Shared University Research, SUR, program began—in 1982. And Bill was selected to run that one as well. The goal was a little different here: IBM would now fund the universities to conduct the advanced technology projects within IBM.

Proposals were solicited from universities. Bill and his SUR Acoustics Council reviewed the proposals and voted, and the winners were awarded two- to three-year contracts. These were generally expected to support graduate students, so Bill's influence actually made it to campuses, supporting graduate student education in acoustics. The result of this: Under Bill's leadership, 25 contracts were supported over the SUR program's 10 years. Many produced master's and PhD theses. Bound versions of these are still at the IBM acoustics lab in Poughkeepsie. Schools awarded contracts included MIT, Penn State, Purdue, and Auburn University.

Now, Bill went out at a high point in his career at IBM, with probably his greatest achievement: the IBM Academy of Technology. Dave Yeager will talk about Bill Lang and especially that accomplishment. Thank you for your attention.

Figure 2.4-1 *Bill accepting a Quality Award. Crew at IBM (left to right): David Yeager, Matt Nobile, Bill Lang, George Maling, and Russ Wise*

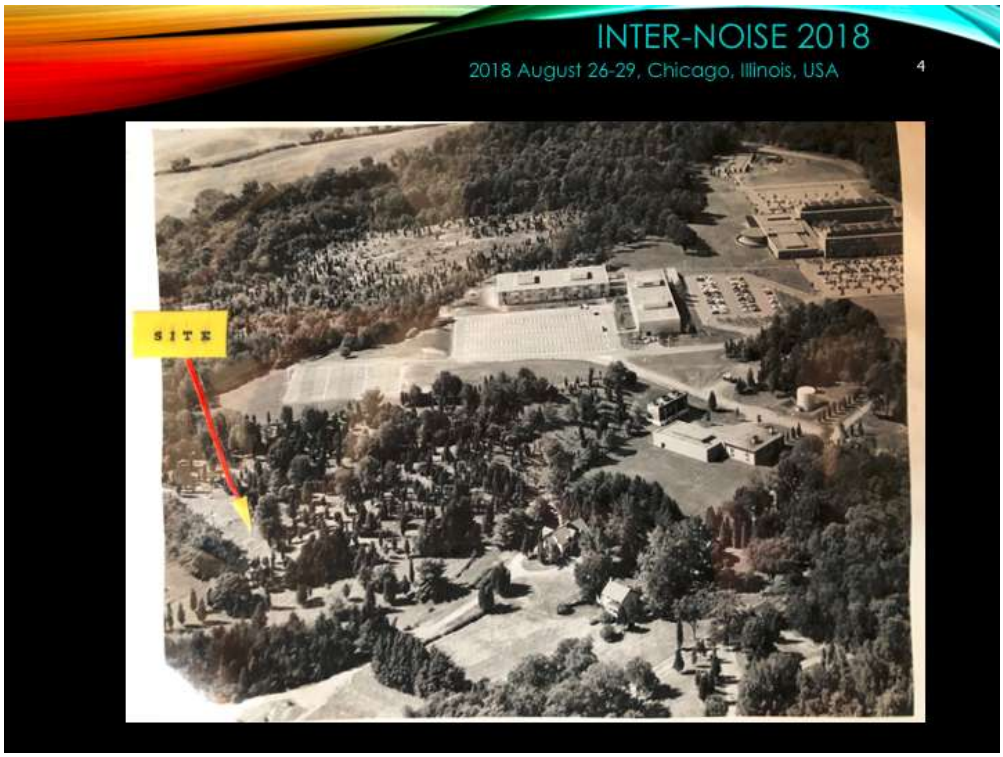


Figure 2.4-2 IBM Acoustics Lab built in this beautiful wooded area

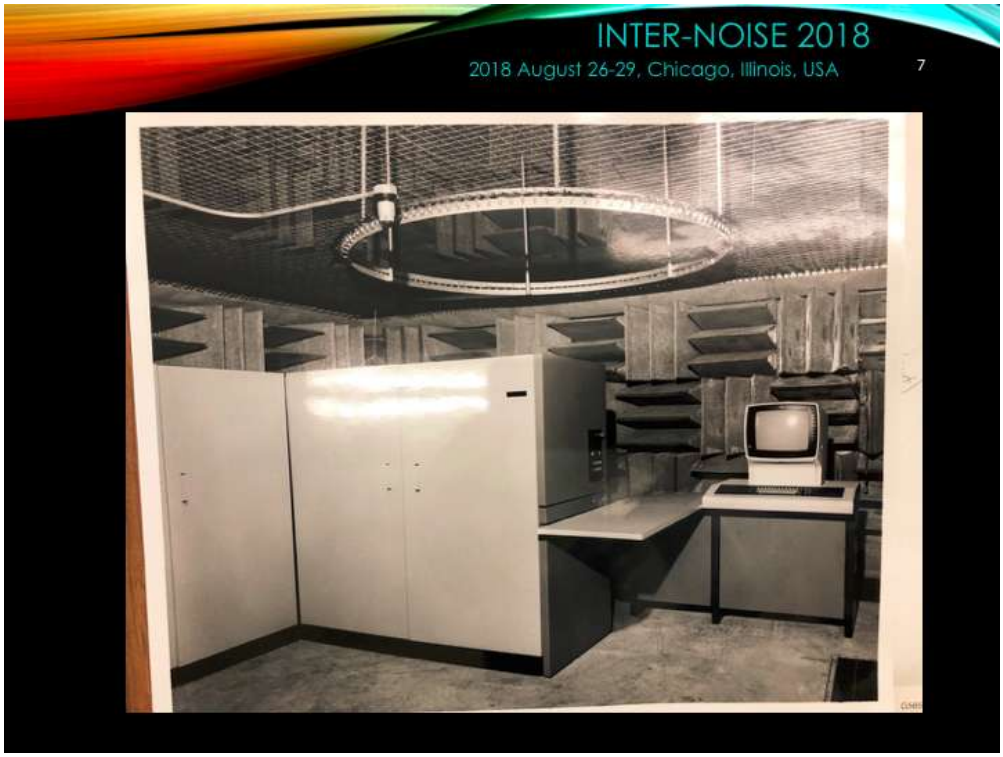


Figure 2.4-3 *The fully anechoic chamber that could be converted into a hemi-anechoic chamber by Bill and laboratory staff moving the wedges*

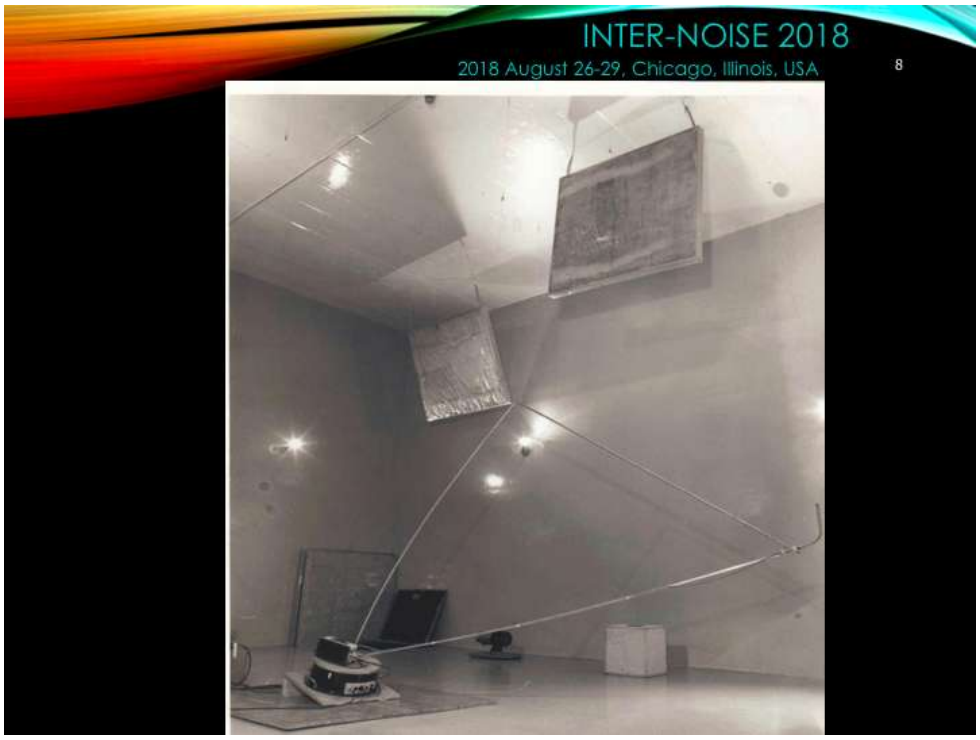


Figure 2.4-4 *The reverberation room in the original building with the first rotating microphone boom constructed at IBM*

Figure 2.4-5 *Bill testing an IBM tape drive in the anechoic chamber*

Figure 2.4-6 *Noisy IBM 1401 printer*

Figure 2.4-7 *Large new wing with a hemi-anechoic chamber, with a special raised floor for testing a new line of mainframe computers*

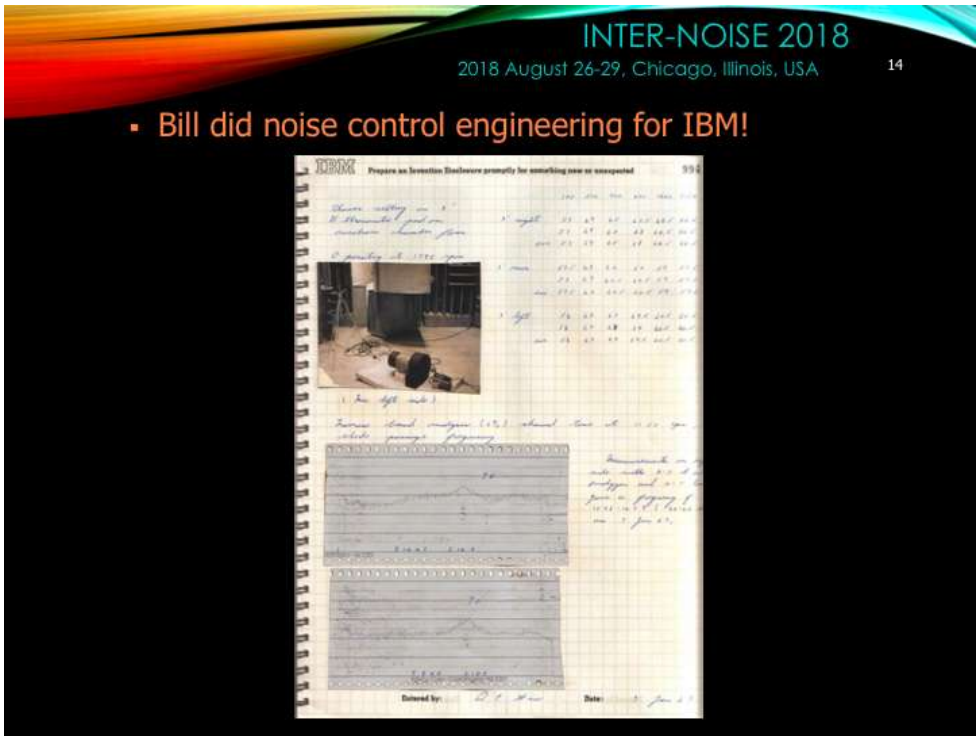


Figure 2.4-8 *Report notes at IBM*

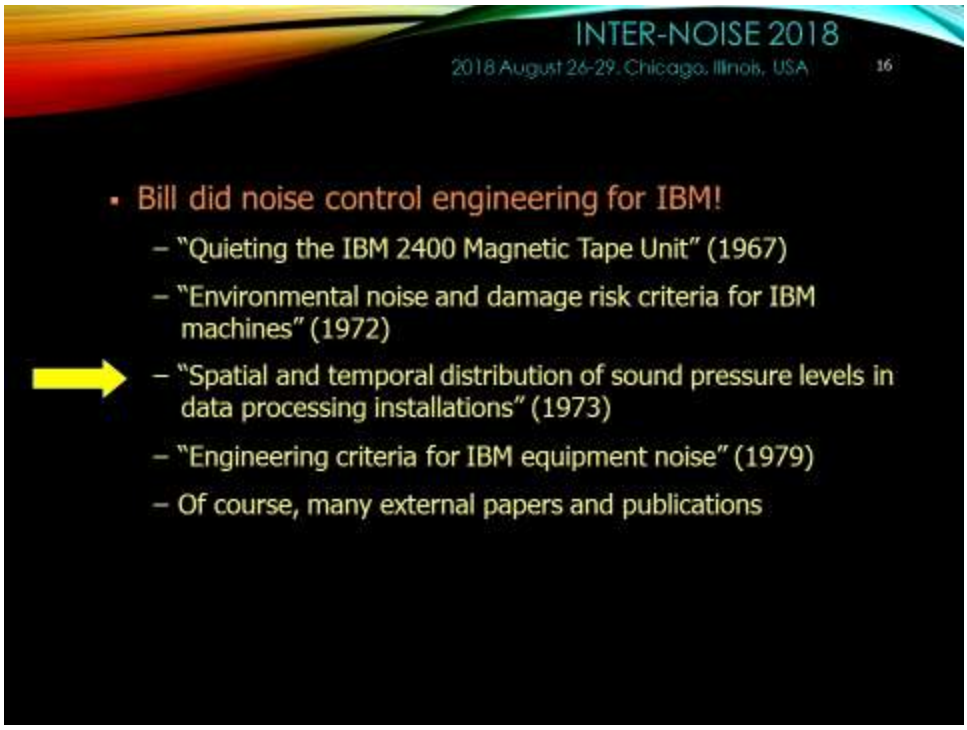


Figure 2.4-9 *Examples of Bill's noise control engineering at IBM*

Figure 2.4-10 *Example of scale modeling of a data center using a spark source and a miniature microphone (by Russ Wise)*

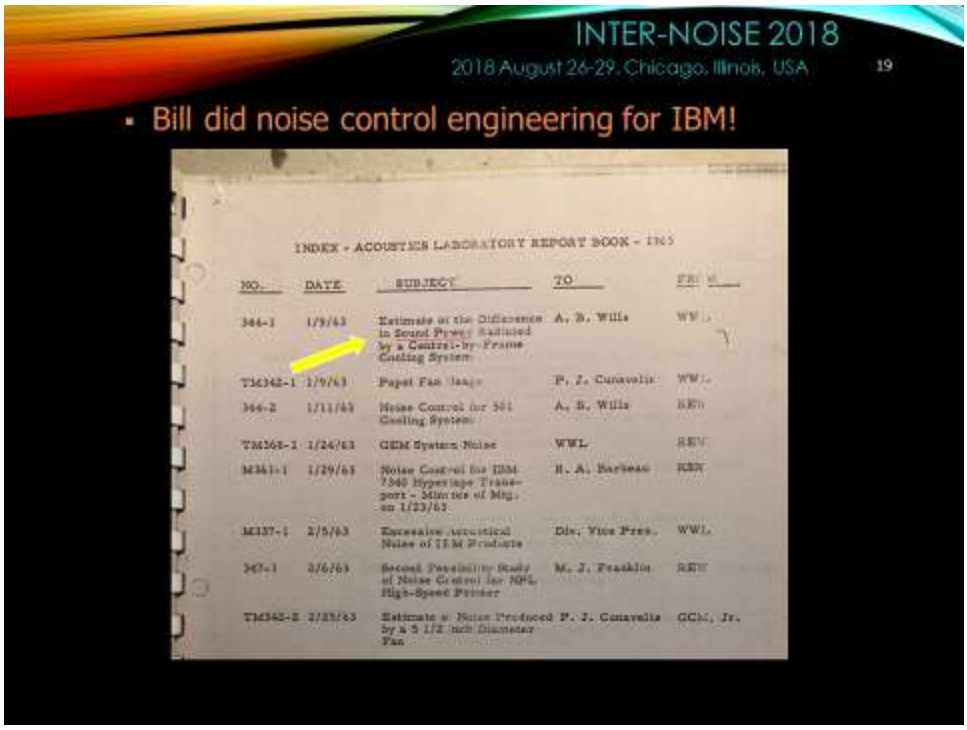


Figure 2.4-11 *Bill Lang 1963 report on the sound power from IBM equipment*

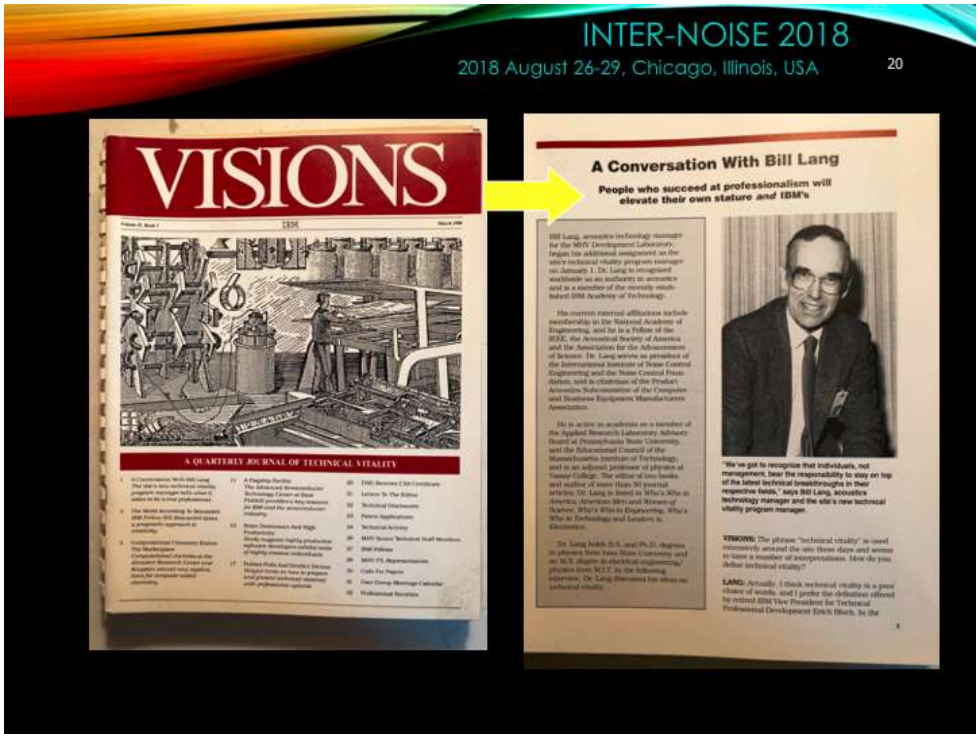


Figure 2.4-12 *IBM technical vitality-focused publication Called "Visions," started by Bill*

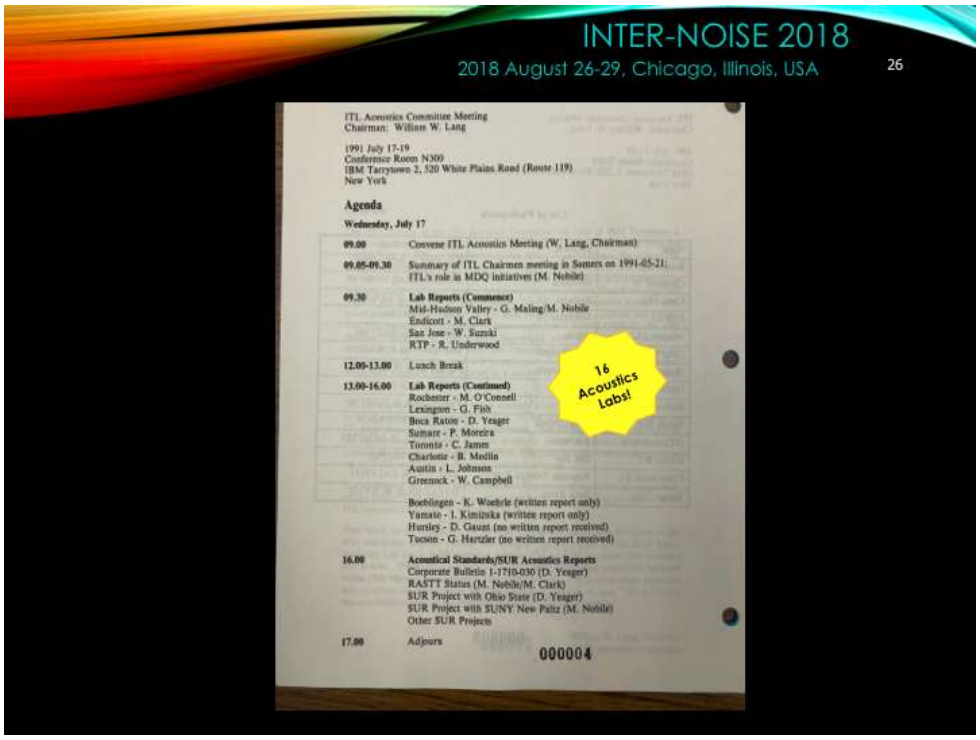


Figure* 2.4-*13 *Bill oversaw sixteen acoustics labs at IBM*

2.5 Bill Lang's Contributions to IBM Acoustics and IBM Generally (Pt 2)

David M. Yeager—Motorola Solutions Acoustic Technology Center, INCE-USA Fellow

Good afternoon. The previous presenters provided informative overviews of many of Bill's notable accomplishments. I will spend the next few minutes focusing on one contribution of Bill's that goes beyond the world of acoustics and noise control at IBM, and that still, to this day, plays an important role in the professionalism of IBM's engineers and technologists—namely, his contribution to the formation of the IBM Academy of Technology. I will share some of the "backstory," and a few of the challenges Bill faced in bringing the Academy to life at IBM.

Before landing at IBM, Bill earned his MS and PhD in acoustics, and found time to court his future wife Asta Ingard for a few months before they eloped. But I digress, and would point you to Rich Peppin's interview of Bill in 2004 that appears on the American Institute of Physics website. As a summary of his accomplishments, however, Figure 2.5-1 provides a list of some highlights up to the year 1978.

In that year, Bill's far-reaching accomplishments in the field of noise control engineering, as one of the founders of INCE-USA and I-INCE, led to his election into the National Academy of Engineering (Figure 2.5-2). It is important to note the significance of NAE membership, which is indeed an achievement of distinction. Election is via a peer group of other NAE members. Election to membership is one of the highest professional honors accorded an engineer. For the typical, high-functioning engineering leader, stopping here would make for an outstanding career! But for Bill, as you know, there's more…

Note that much of the IBM Academy history was compiled by the executive secretary of the Academy in 2000, Yde Vandermeulen, who worked closely with Bill and others in documenting the formation of the Academy. I have "borrowed" Yde's framework for this talk.

Bill recognized the importance of (1) technical professionals remaining current in their field, (2) their involvement in professional societies, and (3) maintaining peer connections. Likely, it was that core understanding that contributed to Bill Lang's being appointed IBM's official representative to NAE in 1985. With that new responsibility, Bill began examining IBM's standing in NAE. At the same time, Eric Bloch (IBM VP of technical professional development) expressed concern to IBM President Jack Kuehler about the company's poor level of participation and membership in the NAE. Just two years prior, in 1984, Bloch had conveyed those views in an *IBM Think* magazine article cited by Bill in his NAE Model report and shown here in Figure 2.5-3:

"*Obviously in a competitive business like ours, we have development deadlines, production schedules and other responsibilities that have to be met every day. But it is equally true that we will only remain competitive as a company if our technical professionals remain technically vital.* "

A two-stage approach was taken to address this: In the near-term, an effort was made to shore up NAE membership by scanning the ranks of IBM's top technologists for suitable candidates, resulting in 11 new members over the next two years, and almost doubling IBM's membership. However, a more fundamental issue became apparent: The best of IBM's engineers are not highly visible to external technologists, nor is there sufficient appreciation for their

achievements. To make significant advancement in these areas would require a more grass-roots approach.

In 1988, Bill and his team published the *Acoustics Technology Study*, a 1,000 page, four-part treatise covering the state of noise control in IBM, from standards to technology to product development. It required a tremendous effort by all authors (Bill Lang, George Maling, Dave Yeager, Matthew Nobile, Russell Wise, and Anne Balant), and represented a comprehensive view of noise control engineering at IBM in the late 1980s. The ATS report included recommended short-and long-term actions to address technical and administrative opportunities.

Part 4 of 4 of the ATS report, "The Day After Tomorrow," was intended to take a broad view (beyond noise control) of IBM's products going forward, and challenge the present state. To quote, "*Because technological innovation is the key to IBM's future, recommendations are made that bear on technical vitality, personnel policies, and product design.* "

In response to the concerns with IBM's participation in the NAE, in 1988 Bill proposed an action plan in a report titled *The NAE as a Role Model for the IBM Corporation* (Figure 2.5-4). This was essentially Part 4 of the *Acoustics Technology Study* report. Note that Bill's perspective as IBM's representative to the NAE went beyond noise control, and included all technology areas, with a special focus on product development.

The four-tiered plan set forth included these basic actions (NAE features are in brackets):

1. Establish "Member Corporate Technical Staff" (CTS) – [best of the best, elected by peers, not appointed by management]
2. Create Technology Centers – [stay abreast of competition and technology advancements]
3. Strengthen existing high-potential programs – [nurture/grow those with potential into the "best of the best"]
4. Promote NAE membership – [external exposure/involvement]

Bill's initial efforts to implement his ideas locally were met with skepticism. He became discouraged and was about to "throw it in the wastebasket," but instead sent a note to IBM President Jack Kuehler, who expressed an interest. Bill's notes shown in Figure 2.5-4 were in preparation for his initial meeting with Jack.

Bill met with Jack in July of 1988 to review the concepts and propose a pilot program for the IBM Academy, which would initially be limited to hardware development. At the direction of Kuehler, over the next four months Bill met individually with Jack's staff. It was generally well accepted, and set the stage for the group, including Kuehler, to convene and share their positions.

Bill met with Jack Kuehler and his staff in Armonk (New York) in December 1988. The image shown is from Bill's records of the meeting (Figure 2.5-5). The group discussed pros and cons, and an agreement was reached. Jack K. assigned IBM Senior VP of Science and Technology Ralph Gomory the responsibility of establishing the IBM Academy, with assistance from Pete Schneider and Bill Lang. They had about six months to work out details.

The IBM Academy of Technology was announced in June 1989 by John Akers, CEO and chairman (see Figure 2.5-6):

"*The IBM Academy of Technology will foster a greater exchange of knowledge among our technical people. I am confident it will strengthen our technological competitiveness and enhance our ability to serve our customers' technical needs.*"

There were 109 original members comprised of currently active IBM Fellows, and other recognized experts from among IBM's worldwide technical professionals. Future members would be selected by the Academy—not by management, per Bill's original proposal, and in alignment with the NAE model. The first meeting would be held in Washington, D.C., inspired by the NAE. The keynote speaker at that meeting was NAE President Robert White.

Ten years later—in retirement—Bill drafted a note to also-retired Jack Kuehler (who retired in 1993) proposing that an "evaluation team of former IBM'ers who were involved with the IBM Academy" be tasked with assessing progress of the Academy. Bill never sent the memo.

The IBM Academy is healthy and thriving today, at 29 years old and with about 800 members (see Figure 2.5-7). George Maling recently exchanged emails with Ginni Rometti, IBM President and John Kelly, IBM Senior VP, the latter confirmed the IBM Academy is "doing quite well and remains vital to IBM" as shown in Figure 2.5-8. I wonder if there's anything planned for the 30th anniversary!

I wanted to mention again, as I did in the beginning, that I have leaned heavily on the IBM Academy history document, provided by Matt Nobile, which was obtained from the online IBM archives, along with several other supporting documents. Thank you very much, Matt! I want to also thank George Maling for providing guidance and encouragement.

To conclude, I want to say: the IBM Academy exists today because of Bill's vision, persistence, and hard work… and his core belief that if you enable the people who want to succeed, they WILL succeed.

Thank you!

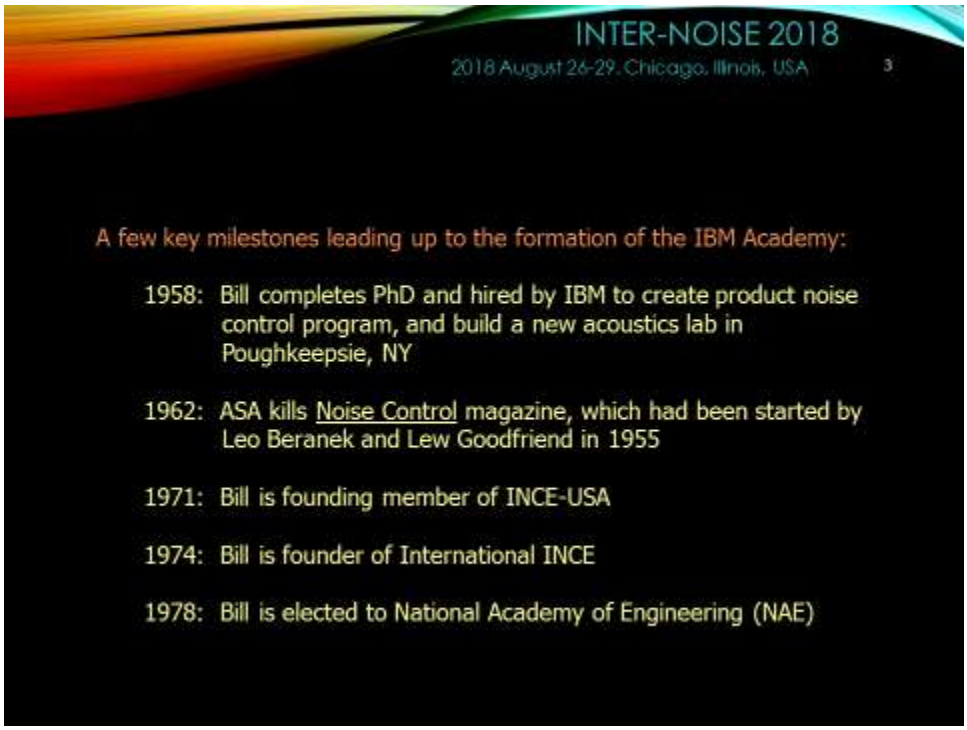


Figure 2.5-1 *Key milestones during Bill's first 20 years at IBM*

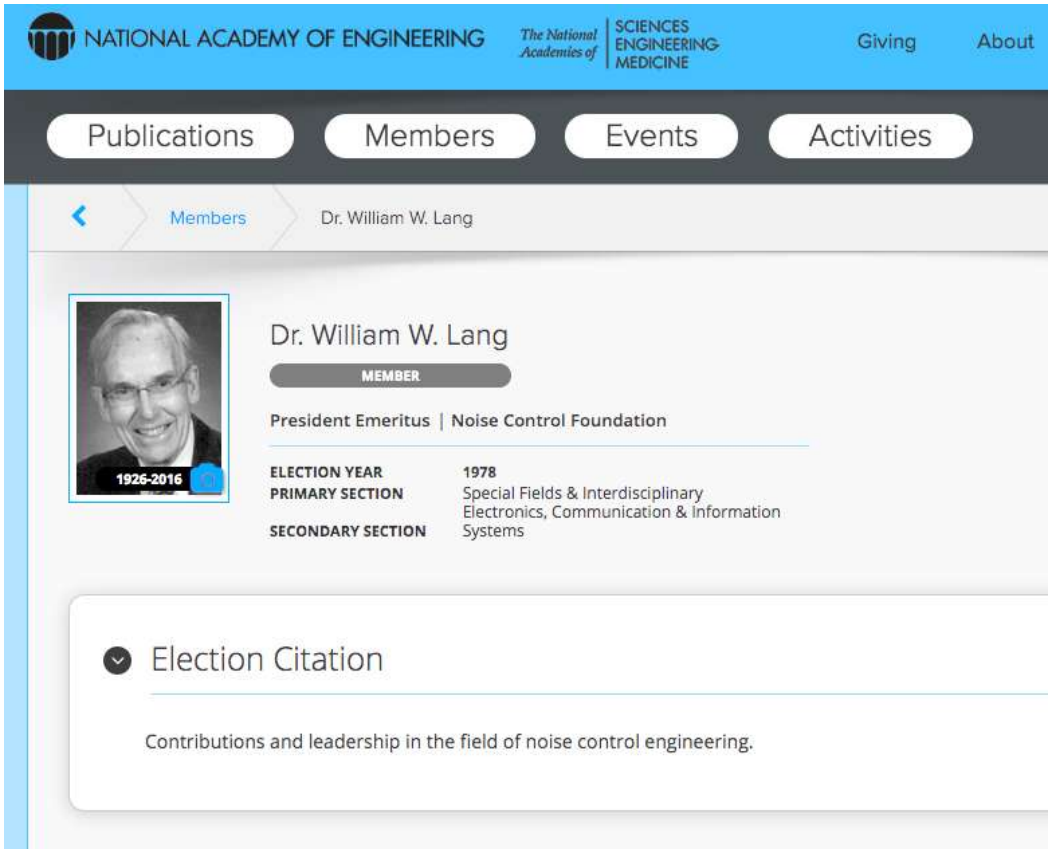


Figure 2.5-2 *Bill was elected to the National Academy of Engineering (NAE) in 1978*

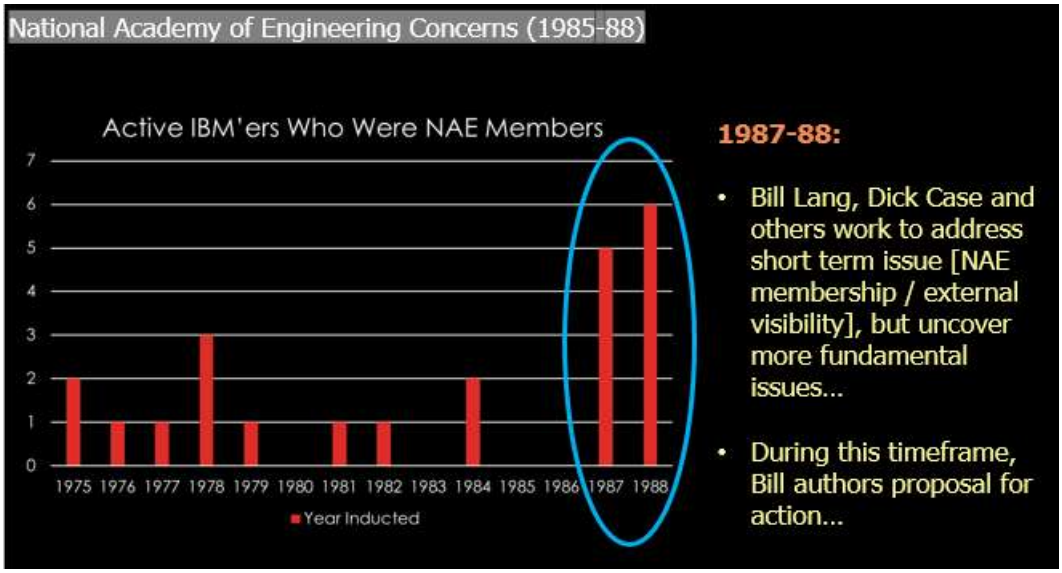


Figure 2.5-3 *A near-term, and successful, effort to shore up IBM membership in NAE uncovered more fundamental issues that needed attention*

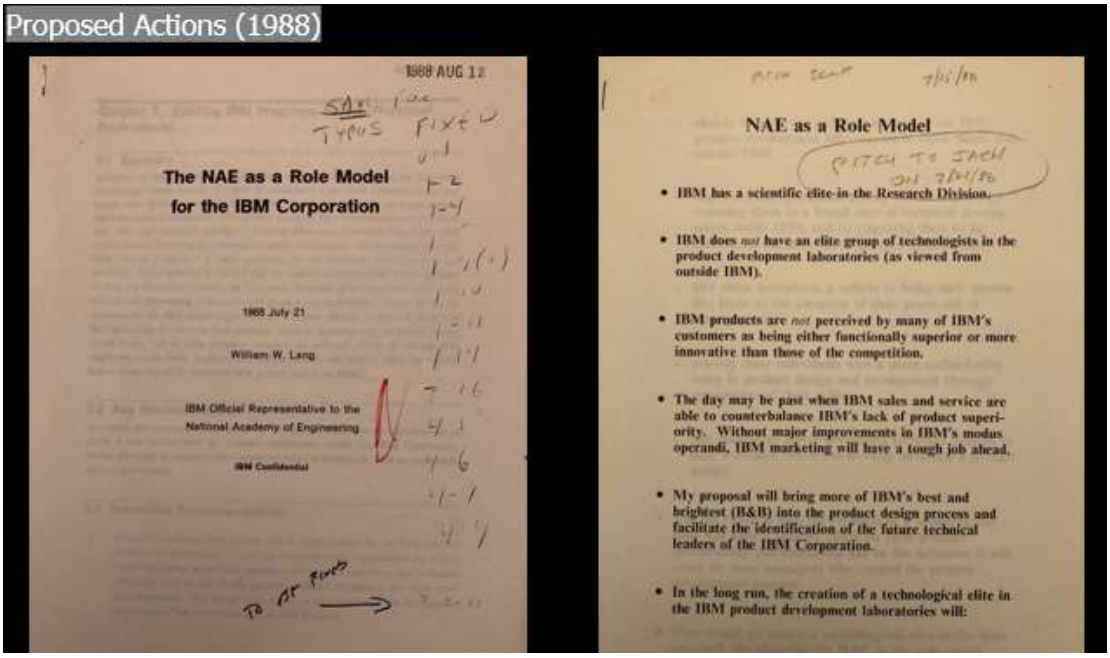


Figure 2.5-4 *Bill's proposal to instill technical vitality in IBM's technical professionals leveraged the structure of the National Academy of Engineering*

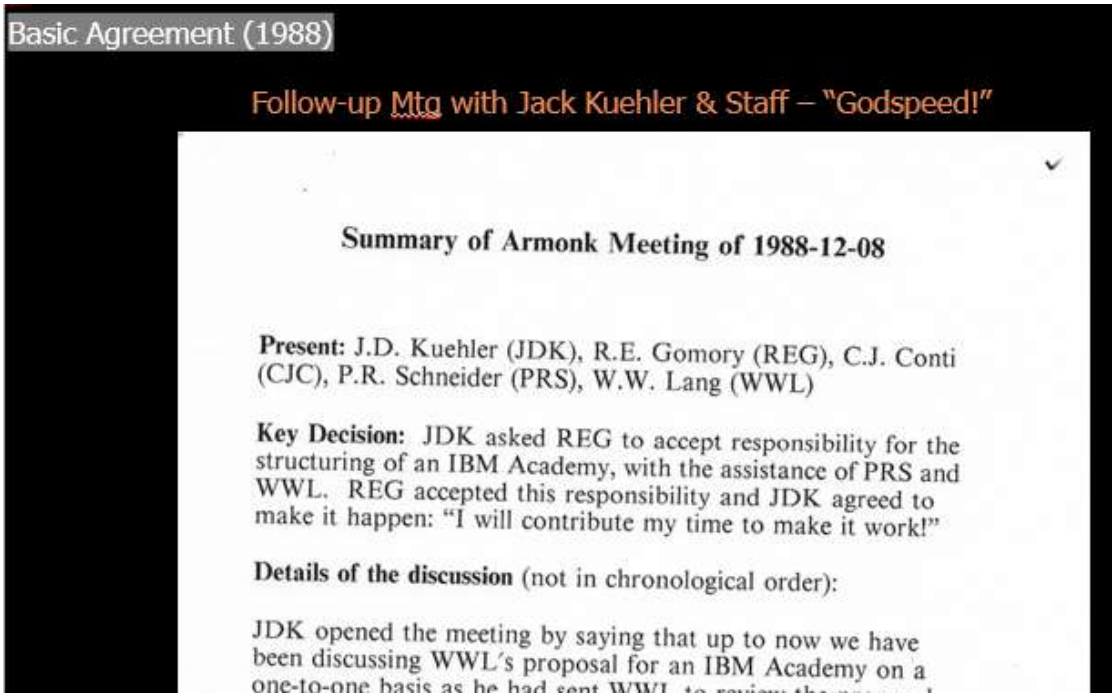
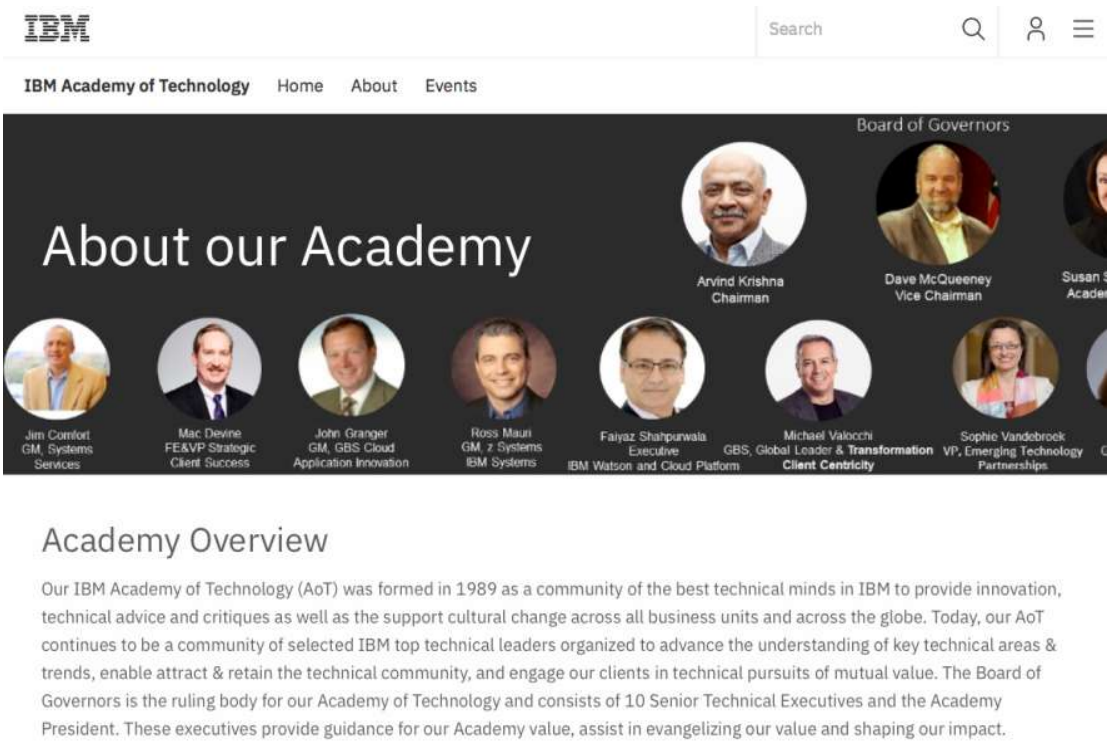


Figure 2.5-5 *IBM President Jack Kuehler endorses Bill's proposal to form an IBM Academy*

Figure 2.5-6 *IBM Academy of Technology announced in June 1989*



Academy Overview

Our IBM Academy of Technology (AoT) was formed in 1989 as a community of the best technical minds in IBM to provide innovation, technical advice and critiques as well as the support cultural change across all business units and across the globe. Today, our AoT continues to be a community of selected IBM top technical leaders organized to advance the understanding of key technical areas & trends, enable attract & retain the technical community, and engage our clients in technical pursuits of mutual value. The Board of Governors is the ruling body for our Academy of Technology and consists of 10 Senior Technical Executives and the Academy President. These executives provide guidance for our Academy value, assist in evangelizing our value and shaping our impact.

Figure 2.5-7 *IBM Academy of Technology website, 2018*

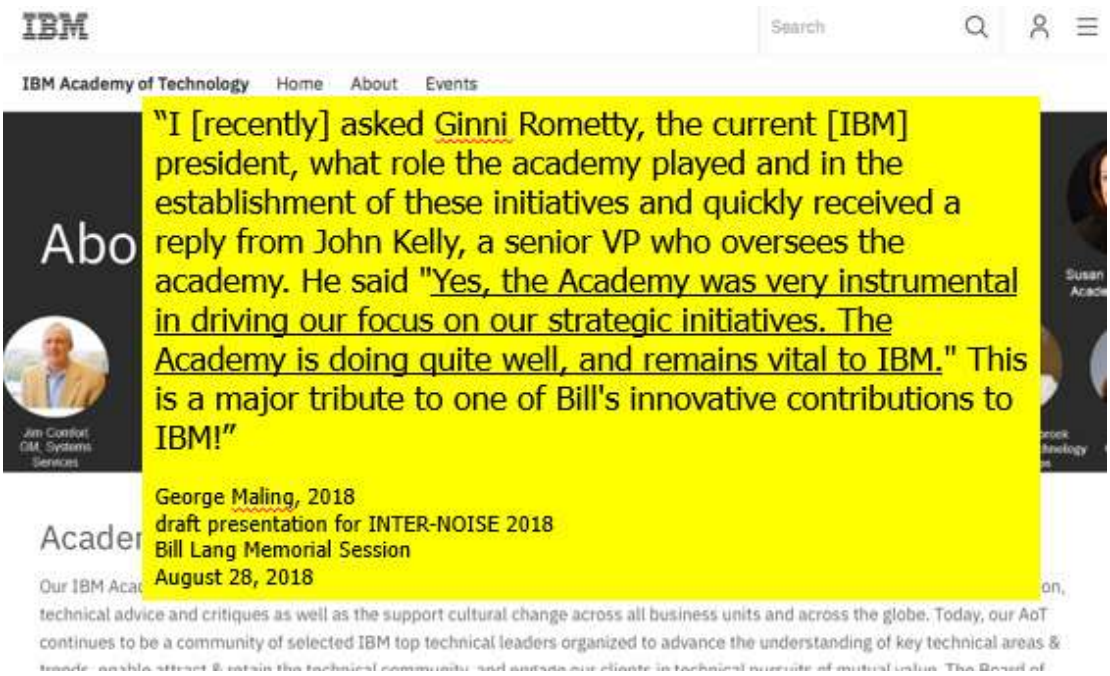


Figure 2.5-8 *In response to email inquiry from George Maling, IBM Senior VP John Kelly confirms IBM Academy of Technology "…doing quite well" today*

2.6 Bill Lang's Contributions to Acoustic and Noise Standards

Robert D. Hellweg, Jr. —Principal, Hellweg Acoustics, and Treasurer, INCE Foundation

Good afternoon. I am with Hellweg Acoustics, and I first met Bill Lang in 1982, shortly after I joined Digital Equipment Corporation (DEC) and began participating in information technology (IT) standards activities. Before joining DEC, I was very familiar with Bill's standards activities—primarily those in the Acoustical Society of America (ASA) standards committees in acoustics and noise.

Bill was a leader in acoustic standards in each of the standards development organizations in which he participated:

- Institute of Radio Engineers (IRE)
- Institute of Electrical and Electronics Engineers (IEEE);
- International Electrotechnical Commission (IEC);
- International Organization for Standardization (ISO); and
- Acoustical Society of America (ASA)

Bill received many awards in recognition of his contributions to the development of acoustic standards. Bill had significant support from IBM management to participate in these standard committees. In a 2004 interview Bill said, "I had a lot to do with ASA, the IEEE, and international standardization—all because IBM wanted its employees to be active in professional activities."

The Institute of Radio Engineers had a professional group on audio, and Bill was part of its Committee 30 on Audio and Electroacoustics. The IEEE was formed when IRE merged with AIEE in 1884, and he was chairman of the IEEE Audio and Electroacoustics Group (see Figure 2.6-1). Previously, George Maling discussed Bill's involvement in the development of the fast Fourier transform (FFT) and the significance it played in acoustical data analysis. In 1967, Bill edited a special edition of the *IEEE Transactions on Audio Electroacoustics* on FFT and its application to digital filtering and spectral analysis; the special edition included a paper co-authored by Bill.

Bill was the chair of the (IEC) Technical Committee 29 on Electroacoustics from 1973 to 1985. The scope of that committee was to prepare international standards related to instruments and methods of measurement in the field of electroacoustics. There are many IEC standards that were produced under Bill's leadership, including sound level meter and microphone standards (see Figure 2.6-2).

Bill was a significant contributor to ISO acoustics and noise committees: ISO Technical Committee (TC) 43 (Acoustics) [ISO/TC43] and TC43 Subcommittee 1 (Noise) [ISO TC43/SC1]. From 1970–1980, Bill was the convener of the ISO TC43/SC1 working group 6 on noise emitted by machinery and equipment, which developed the ISO 3740 series of standards on measuring sound power levels. Bill was a proponent of sound power as the primary descriptor of machinery equipment and product noise, and recognized the need to have effective, reliable, and uniform measurement procedures. As Matt Nobile indicated in his presentation, IBM was measuring sound power levels of its products in the early 1960s.

In 1985, Bill was the chair of ISO TC43/SC1 study group H on the revision of sound power standards. As a result of that study group, a new ISO TC43 Working Group 28 (First

known as Working Group 6.—Ed.) was formed on noise emitted by machinery and equipment, with Bill as the convener from 1988 to 2012. The ISO 3740 series of standards on sound power were revised; currently there are seven standards in that series. In addition, WG 28 developed the ISO 11200 series on product emission sound pressure levels, with five standards in that series (i.e., the sound pressure level at the operator or bystander positions near the product). WG 28 also developed ISO 12001 on rules for preparing machinery-specific noise standards or test codes. In addition to basic standards that applied to all types of machines and products, he was convener of the ISO TC 43/SC1 WG 23 on information technology (IT) noise from 1980 to 1991 (see Figure 2.6-3).

Bill successfully managed and led the development and revision of these many ISO standards. Hans Kornprobst, who is the current secretariat of both ISO TC43 and ISO TC43/SC1, said that Bill's "major contributions are the standards for the measurement of the noise emission of machinery equipment, including IT equipment" (see Figure 2.6-4).

For many years, Bill was head of the U.S. delegation to the ISO TC 43 and ISO TC 43/SC plenary committee meetings. In the 1970s and 1980s, Bill coordinated the U.S. position and comments on all of the draft ISO acoustic and noise standards.

The Acoustical Society of America is secretariat for five American National Standards Institute (ANSI) accredited standards committees (ASC). Bill was a leader and significant contributor on three of these committees: S1 (Acoustics), S3 (Bioacoustics), and S12 (noise). Among other responsibilities, he was an individual expert on each of these committees (see Figure 2.6-5).

On the ASA ASC S1 acoustics committee, Bill was chair for several years. He chaired a four-day workshop in 1971 on home appliance and consumer product noise and rating. As result of that conference, the ANSI S1.21-1972 standard on sound power level of small sources in reverberation rooms was approved, and the ANSI S3.17-1975 standard on the rating of sound power spectra of small sources was approved.

On the ASA ASC S12 noise committee, Bill worked on machinery and equipment standards for many years. This work on the machinery equipment noise standards in ASA ASC S12 was used in the ISO standards development and vice versa. Today the ANSI/ASA S12.50 series of sound power standards is a nationally adopted ISO 3470 series of standards. As an example of his desire to have standards that were readily usable, the four-part ISO 7574 standards on product noise labeling was condensed and simplified by Bill and four others into a smaller one-part U.S. version (ANSI/ASA S12.3).

Bill played a minor yet significant role in the important standard ANSI/ASA S12.60 on classroom acoustics. One trade association appealed that standard first to ASA and then to ANSI. As part of the appeal, an ANSI appeals board was selected by both the trade association and ASA, and the appeals board consisted of Bill Lang, Ken Eldred, and Tony Embleton. After hearing and considering arguments by both sides, the appeals board rejected the appeal, and ANSI/ASA S12.60 was approved in 2002. This ANSI/ASA standard on classroom acoustics is one of the most significant and popular ANSI/ASA standards.

For his outstanding contributions and leadership in acoustic and noise standards, Bill received several recognitions and awards. It was mentioned in a previous presentation that Bill was elected to the National Academy of Engineering. Bill received the Acoustical Society of America's Silver Medal in Noise in 1984, and he received the INCE Distinguished Noise Control Engineer Award for leadership in 2002. Both of those awards cited, among other things, his contributions in standards (see Figure 2.6-6).

In 1971, Bill was elected as an IEEE Fellow for contributions in engineering acoustics, noise control, digital signal processing of signals, and *establishing acoustical standards*. In 2009, he was elected as one of the first Fellows in the INCE-USA, and the citation read in part *"... for contributions to noise standards both nationally and internationally."* Previously he was elected a Fellow in ASA with the citation reading "*For leadership in acoustic standardization and analysis of impulse noise*. In addition, he was elected a Fellow in the Audio Engineering Society and the American Association for the Advancement of Science (see Figure 2.6-7).

There are two oral history interviews with Bill that are available on the internet–each revealing interesting aspects of his career. The first is an interview by Andrew Goldstein for IEEE in 1997: https://ethw.org/Oral-History:William_Lang. The second is an interview by Rich Peppin for ASA in 2004: https://www.aip.org/history-programs/niels-bohr-library/oral-histories/29970

Bill served in several significant roles within the Acoustical Society of America for many years, in addition to his standards activities. He was the chair of the ASA Technical Committee on Noise, ASA Treasurer, an associate editor on noise for the *Journal of the Acoustical Society of America*, a member of the ASA Executive Council, and a chair of the ASA publication policy committee.

I think we should all thank Bill for his many contributions to the development of acoustic and noise standards that support and benefit noise control engineering and the public. It was a pleasure for me to know Bill and to have worked very closely with him for many years.

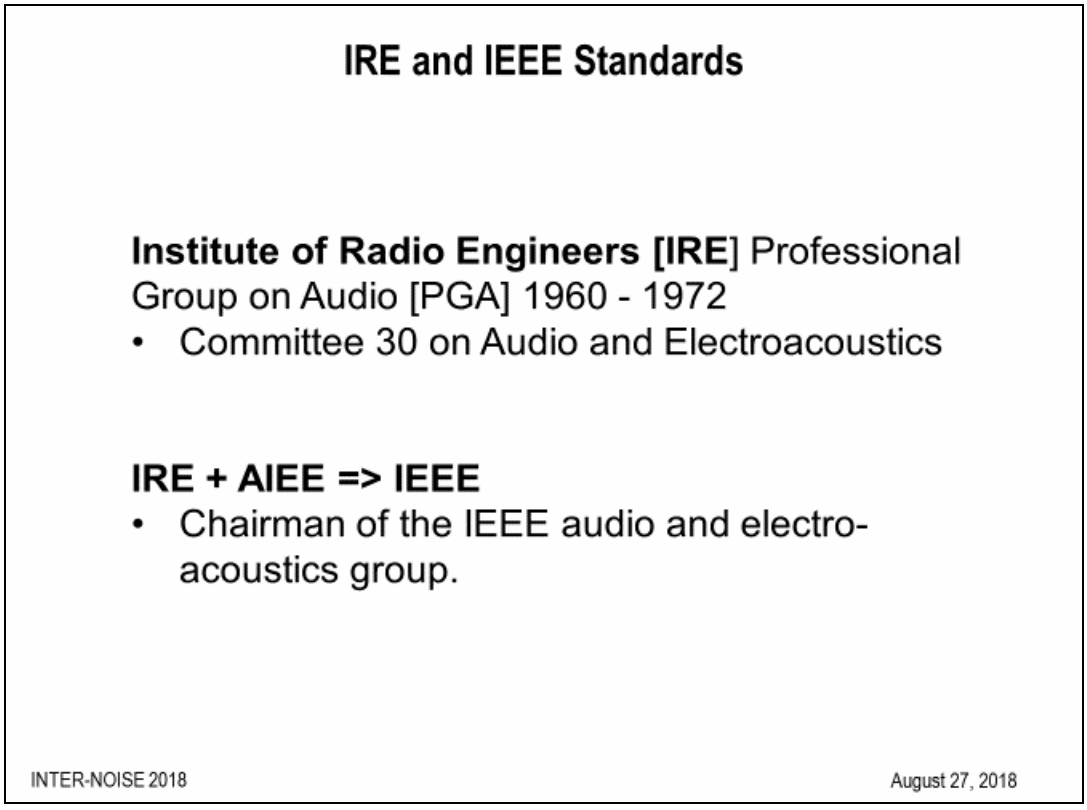


Figure 2.6-1 *William Lang participation in IRE and IEEE standards*

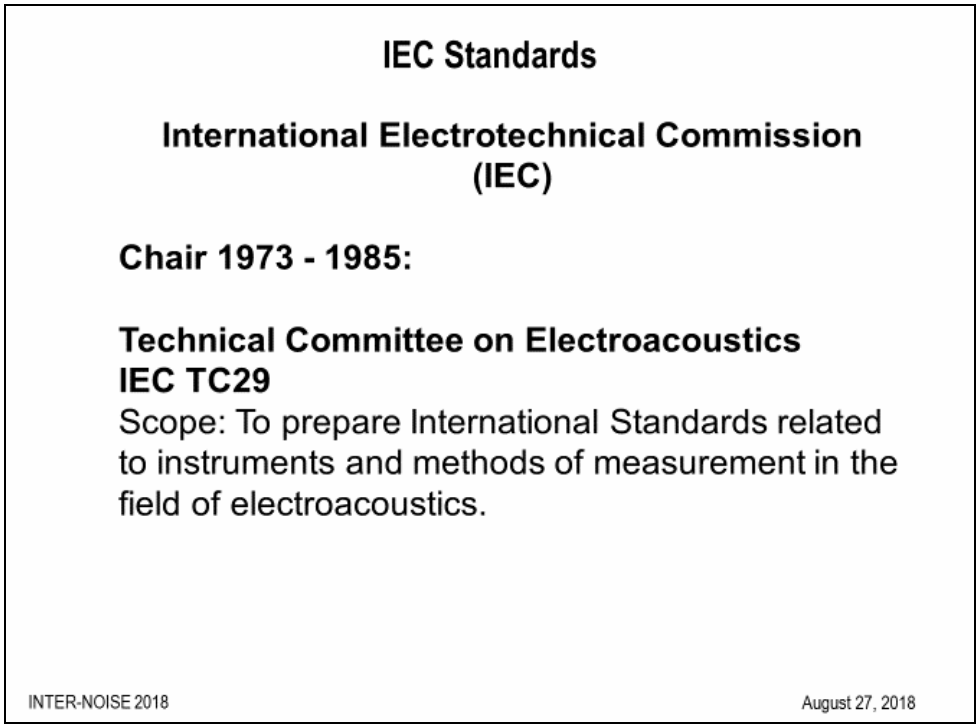


Figure 2.6-2 *William Lang participation in IEC standards*

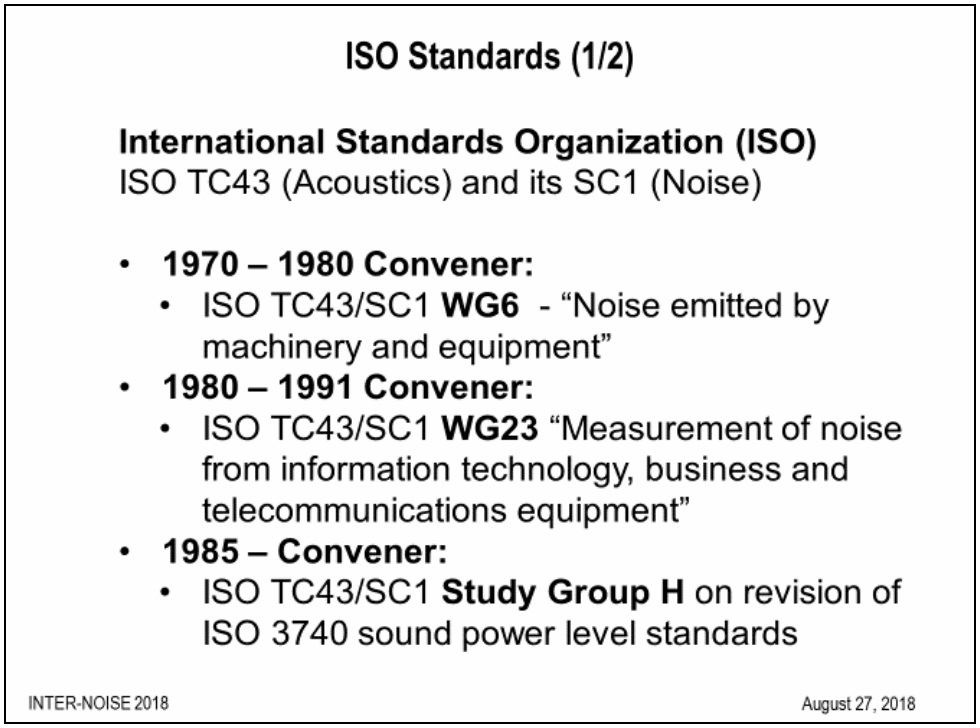


Figure 2.6-3 *William Lang participation in ISO standards (1/2)*

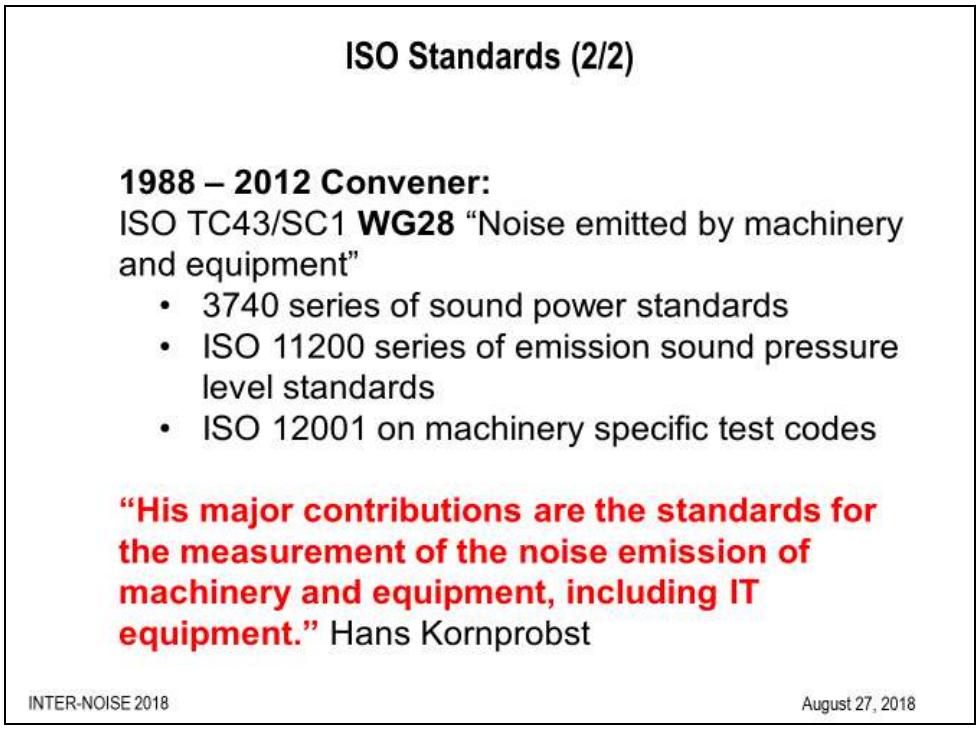


Figure 2.6-4 *William Lang participation in ISO standards (2/2)*

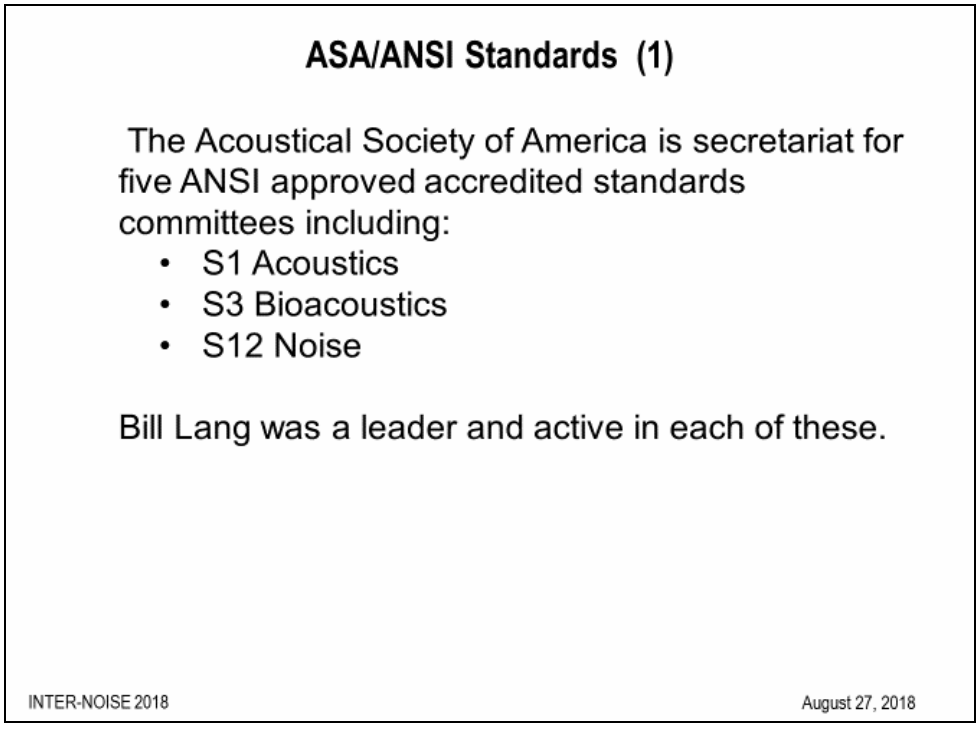


Figure 2.6-5 *William Lang participation in ASA/ANSI standards*

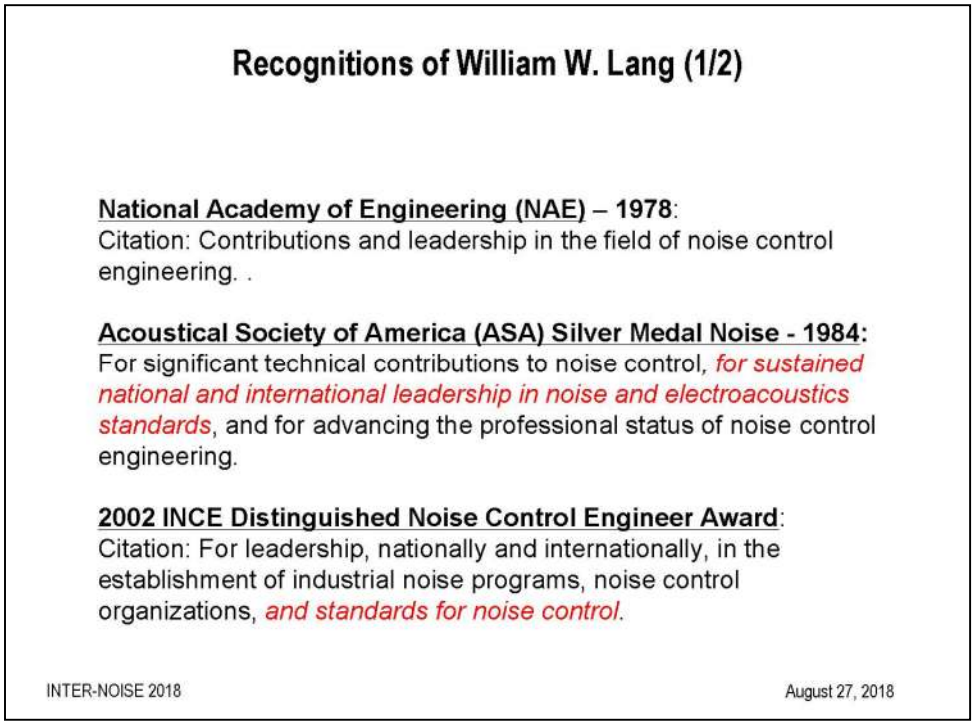


Figure 2.6-6 *Awards and recognitions of William Lang (1/2)*

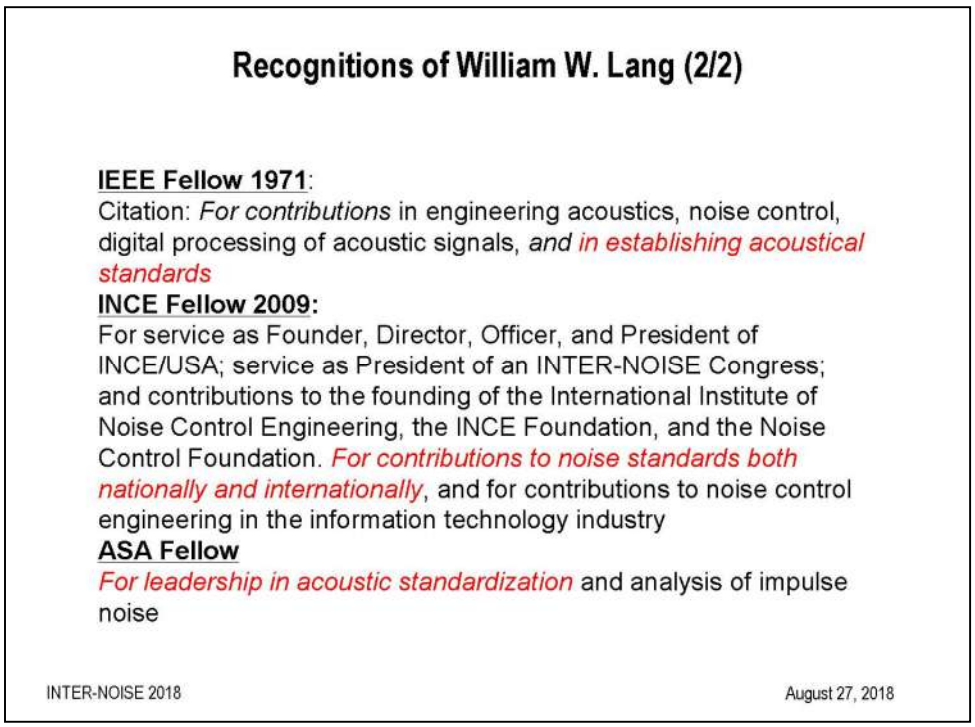


Figure 2.6-7 *Awards and recognitions of William Lang (2/2)*

2.7 Bill Lang: Vital Contributions to Technology for a Quieter America and Follow-on Workshops

Eric W. Wood—Principal, Acentech Inc., and President, INCE Foundation

I'm going to share information about Bill and his work with Technology for a Quieter America. I'm very grateful to Bill Lang for his kindness and encouragement during the many years we enjoyed working together (Figure 2.7-1).

Starting in early 2000, Bill helped to form and provide leadership to a joint international committee that united the noise control policy and technology committees of I-INCE and CAETS. CAETS is the International Council of Academies of Engineering and Technological Sciences. These are organizations like the NAE but worldwide. The purpose of this joint committee that Bill established included promoting the reduction of noise emission of the principal noise sources worldwide and disseminating knowledge in this field to decision-makers and manufacturers, consumers, and the public. About 18 years ago, Bill Lang established what we call the "Peabody Group."

We named it the Peabody Group because we first met in Peabody, Massachusetts. The purpose of this group was to address and provide guidance for a needed unified noise control policy—a policy that is protective of our health and well-being. And it's a policy that assists U.S. industry in being competitive in world markets with respect to product sound. This group included 10 specialists, as well as members of the National Academy of Engineering. Somewhat later, Bill organized the INCE Study Team on National Noise Policy.

This INCE Study Team presented seven invited papers and conducted panel sessions during INTER-NOISE 2002 in Dearborn, Michigan. Noise policy was also addressed by team members during NOISE-CON 2001 in Portland, Maine. Special issues on national and international noise policy were published in the July 2001 and May 2003 issues of the *Noise Control Engineering Journal*.

Later, with Bill Lang's support, a series of workshops was held by the National Academy of Engineering during 2005 to 2009. George Maling served as the committee chair for the workshops. Pertinent results and recommendations are documented in the report shown in Figure 2.7-2. The *Technology for a Quieter America* report was published in 2010 by the National Academies Press, and is now available for download without cost from the National Academies website, at: www.nap.edu/catalog.php?record_id=12928. And I will pass out this excellent report to you in the audience. The Technology for a Quieter America workshops have reviewed the present state of technology in noise control engineering. They have also investigated how current technology could be used to reduce exposure to noise in the U.S.

The report offers many recommendations. In talking about the National Academy of Engineering, I like to mention this noteworthy historic detail: The NAE operates under a charter granted to the National Academy of Sciences by Congress. But when was the charter granted? During the administration of Abraham Lincoln, in 1863. The NAE was founded in 1964.

Bill was a leader and financial supporter in establishing TQA follow-on program workshops that started in 2012—workshops that have been developing relevant recommendations aimed at improving the noise climate here in the U.S. The TQA follow-on workshops assess specific noise issues by involving experts in selected TQA topic areas, and publish a series of recommended remediation measures.

During 2012 to 2018, we organized and held eight TQA follow-on workshops with Bill. The ninth workshop is scheduled for the end of 2019.

The first NAE workshop, "Protecting National Park Soundscapes," was a traditional consensus study hosted by the National Park Service in Fort Collins, Colorado, on October 3–4, 2012. Natural quiet is an important aspect in many of the hundreds of properties managed by the National Park Service. It's important to both visitors and wildlife. This workshop was organized according to NAE procedures as published in Section 15 of the Federal Advisory Committees Act. Its focus was to develop and provide advice to assist park managers in controlling noise—noise, for example, from transportation, maintenance, and construction in the parks. Twenty-four workshop participants included park personnel and noise control specialists. The experts identified 17 cost-effective actions for reducing noise in our national parks. This report is available as a PDF document at no cost from the National Academies Press website, at: http://www.nap.edu/catalog.php?record_id=18336

The next TQA follow-on workshop, "Noisy Motorcycles—An Environmental Quality of Life Issue," was sponsored by the INCE Foundation and the Noise Control Foundation, and hosted by the National Academy of Engineering in Washington, D.C., on October 24, 2012. This was the first of the series of our workshops produced using an *ad hoc* version of the new procedure Bill developed with the NAE, that NAE President C.D. (Dan) Mote Jr. mentioned. The NAE approved Bill's procedure and provided partial funding.

The reports from the seven workshops conducted under this new procedure are all available for free download from the INCE-USA website, as shown in Figure 2.7-3 (https://www.inceusa.org/publications/technical-reports/).

More than 30 years ago, the EPA enacted a federal regulation to limit noise from motorcycles designed for on-road use. It's a well-intended federal regulation, and motorcycles today come from the manufacturer with well-designed and effective exhaust systems. However, noise problems occur when some bike owners replace the original exhaust system with noncompliant components. Some bikers just want loud bikes.

This roundtable on motorcycles was attended by 29 experts representing manufacturers, rider organizations, government agencies, universities, noise control consultants, and the public. The workshop and report aimed to address problems such as the old federal motorcycle noise regulations not reflecting current motorcycle design technology or operator use patterns, and portions of the regulation currently precluding effective enforcement of motorcycle noise by state and local authorities. The report includes 30 recommendations for addressing these types of issues. Goals of the roundtable included identifying changes to the federal regulation in light of today's technology, and assisting state and local governments wanting to reduce motorcycle noise.

The next workshop, "Cost-Benefit Analysis: Noise Barriers and Quieter Pavements," was sponsored by the INCE Foundation, the Noise Control Foundation, and the Transportation Research Board Committee ADC 40. It was organized in cooperation with the U.S. Department of Transportation Volpe Center, and hosted by the NAE in Washington on January 16, 2014.

It is well recognized that highway noise is a quality-of-life issue. We're all familiar with the roadside noise barriers being built to protect nearby neighbors. More than $5 billion has been spent constructing more than 3,000 linear miles of roadside noise barriers. At highway speeds, the main source of noise emissions from highways is the interaction between the tires and the road surface. Considerable research and development work has shown that changing the design of the road surface can reduce noise emissions. A purpose of this workshop was to address the costs and benefits of highway noise barriers, lower-noise road surfaces, and combinations of

both barriers and quieter pavement. Ten findings and recommendations are provided in the workshop report, based on presentations by 23 experts.

The next workshop focused on reducing employee noise exposure in manufacturing. Participants discussed current conservation programs in manufacturing industries, best practices and innovative techniques for engineering noise control in this context, and a vision for the manufacturing workplace of the future. This workshop was sponsored and organized by the INCE Foundation, the Noise Control Foundation, and the National Institute of Occupational Safety and Health. It was hosted in Washington on February 19–20, 2014, by the National Academy of Engineering.

More than 20 experts attended and contributed to this workshop. Approximately a third of the workshop addressed the availability of effective low-cost techniques for the reduction of noise in industry and the design of low-noise machines for industrial use. The second third addressed techniques for reduction of noise through changes in the processes within the industrial plant. And the final third addressed the future manufacturing environment and implications for the future of new noise goals in manufacturing facilities.

The next workshop addressed progress made over the past few decades on consumer and industrial product noise reduction. Contributions of noise control engineers have improved quality of life and the U.S. economy by providing domestic manufacturers with the expertise to develop, produce, and sell quieter products that are desired globally. Anticipated future noise control engineering technologies were also addressed during the workshop. This workshop was held in Washington on October 6–7, 2015. It was organized by the INCE Foundation and the Noise Control Foundation, and was again hosted by the National Academy of Engineering

Thirty-one persons attended this workshop, with presenters representing manufacturers, consultants, trade and standards associations, universities, and a well-known consumer publication. Many of the attendees had 30 to 40 years of direct engineering experience in consumer at-home products or industrial products. The workshop addressed consumer products ranging from automobiles to waste disposal systems to leaf blowers, and industrial products ranging from air-moving devices to valves. Products discussed ranged from small handheld devices to million-pound off-road trucks.

The next workshop, focusing on the transfer of noise control technology, was held in Washington on October 11–12, 2016. It was organized by the INCE Foundation and the Noise Control Foundation, and was again hosted by the National Academy of Engineering. The workshop looked at current research by government, universities, and the private sector. It considered which research holds promise for translation into useful, innovative noise control solutions, and ultimately for improving the ability of engineers to solve problems and improve the competitiveness of U.S. industry. This workshop was attended by Bill Lang, of course; his son, Bob Lang; and 32 other experts.

Shortly before Bill's passing on October 23, 2016, the NAE announced a new policy based on the model Bill developed after extensive discussions with President C.D. Mote Jr. This new NAE policy makes official the procedure for member-initiated activities such as these workshops.

The 2017 workshop, titled “Commercial Aviation: A New Era,” was organized by the INCE Foundation. It was conducted in cooperation with NASA and FAA, and hosted by the NAE, in Washington, D.C., on May 8–9, 2017. This, the first workshop developed completely under the new Bill-initiated NAE policy, was attended by more than 40 experts representing

airplane and engine manufacturers, aircraft research organizations, airlines and cargo operators, airports, universities, NASA, the FAA, consultants, and interested communities.

The United States is a global leader in aviation technology. A principal focus of this workshop included step-changes in technology of future aircraft necessary for the U.S. to maintain its global leadership position and the very positive trade balance that aviation brings to the U.S.

The vital importance of government funding required to continue X-system development in flight testing was emphasized by presenters at this workshop. While significant progress has been made in reducing noise from commercial aircraft, it was concluded that additional government support in aeronautics is needed to maintain this country's global leadership position. This is particularly true now, given the immense government support being provided in other countries—notably, within the European Union and by China.

The next workshop, held in Washington, D.C., on December 13–14, 2018, focused on unmanned aerial systems/unmanned aerial vehicles, or drones. It was again organized by the INCE Foundation, in cooperation with NASA and the FAA, and hosted by the NAE.

Unmanned aerial vehicles are expected to become a common part of our national airspace within the next few decades. At the workshop, experts from government, academia, and the private sector addressed future uses, noise emissions, and noise control technologies.

In terms of these reports I've been passing around—and I have plenty more back in my office—do me a favor and take one home if you want one. That way I don't have to bring any home! And if anybody wants additional paper copies, just let me know, and I can make that happen.

In conclusion: Thank you, Bill. Thank you for your friendship, mentorship, and decades of contributions to global noise policy and noise control engineering. And yes, for our sustenance. Thank you. (See Figure 2.7-4.)

Two notes were added by Chairman Bob Bernhard following the tribute by Eric Wood. Chairman Bernhard stated:

In speaking with George Maling about Bill's support for TQA, George said something to the effect of, "Well, you know, Bill provided significant financial support to TQA." Of course, Bill was too modest to mention this. (Bob Bernhard is correct. Bill never mentioned it. But the NAE acknowledged the gift in the front material of the TQA Report.—Ed.)

Also, Bill's son, Bob, mentioned today during lunch how important the TQA effort was to Bill after Asta's passing, as a real opportunity for release by working on something so important.

Figure 2.7-1 *Opening slide*

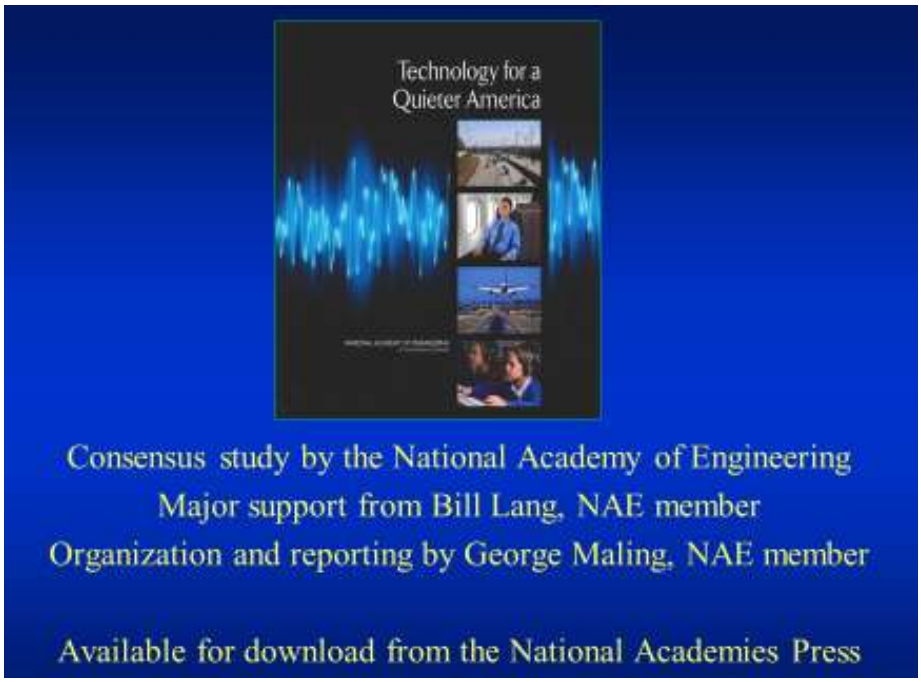


Figure 2.7-2 *Technology for a Quieter America report*

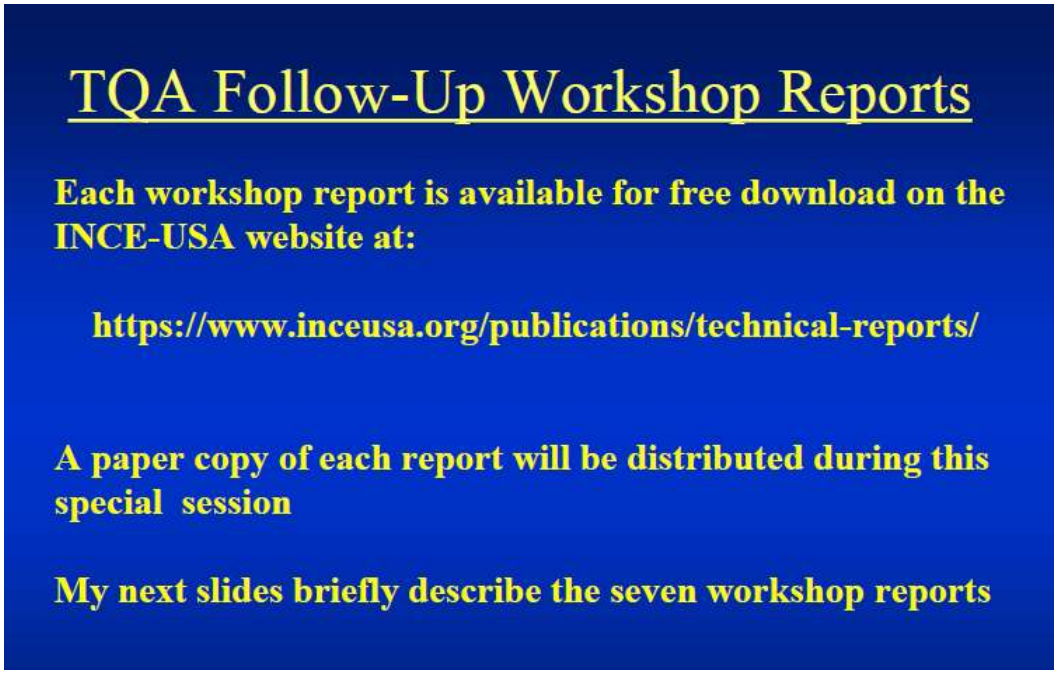


Figure 2.7-3 *Where to find TQA workshop reports*

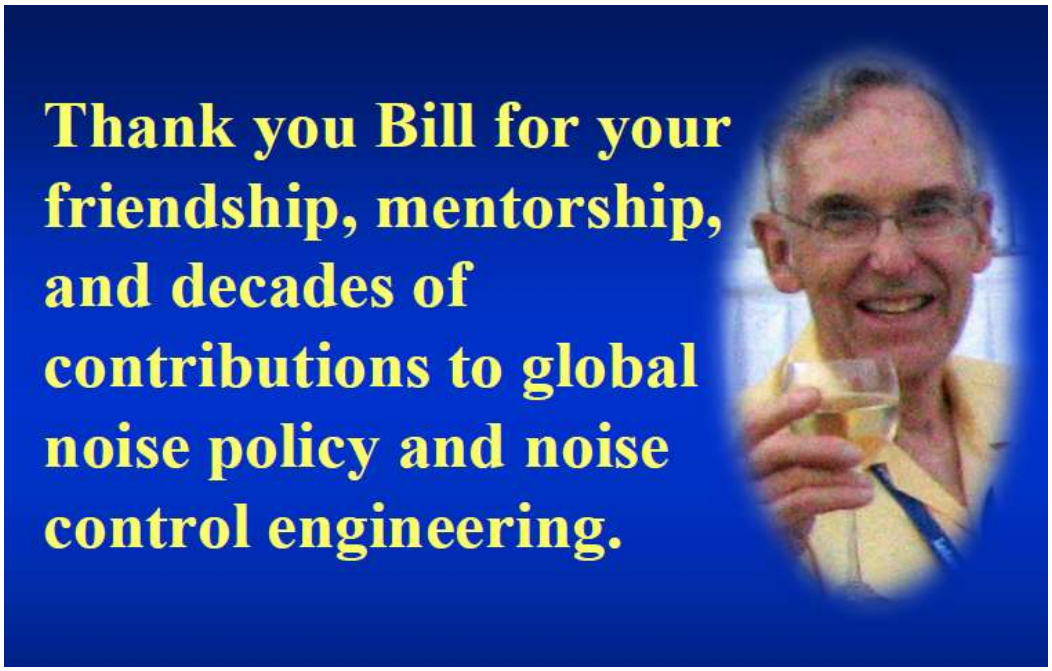


Figure 2.7-4 *Closing slide*

2.8 Bill Lang and Global Noise Policy

Tor Kihlman—Professor Emeritus, Applied Acoustics, Chalmers University of Technology (via video)

Dear Colleagues and Friends, thanks for the invitation to contribute to this session in memory of William W. Lang. For many years, I worked closely with Bill, especially within I-INCE. Bill strongly influenced this organization from its founding in 1974 until his passing two years ago. Bill saw the mission for I-INCE as wider than just an organization for holding congresses. He undertook many initiatives to improve I-INCE's engagement and effectiveness in promoting a quieter world, and also to get other organizations engaged in this topic. His ultimate goal was very ambitious: a world in which quiet reigns, a world in which the quality of life is not diminished by noise.

By this he meant a state far beyond just fulfilling today's minimum standards for community noise and workplace noise. These standards are compromises. They seldom guarantee good acoustic conditions. Bill Lang had many strings to his bow and had a remarkable work capacity. He gave enormous amounts of his time to voluntary work toward a world free from the adverse effects of unwanted or hazardous noise.

His network was large; he was indefatigable, always ready to take on new initiatives. He never gave up. He had a strategic way of thinking. He was a profound organizer. He continuously developed, updated, and expanded the horizons and made amendments to bylaws and rules and had interactions with congresses, etc. Bill Lang realized that noisy workplaces, noisy cities, and noisy products will not get much quieter by congresses alone, where good papers on noise control are communicated to colleagues. We as professionals also have the responsibility to ensure that our specialized knowledge gets put into practice in society. Therefore, it is also our duty as specialists to communicate with the public and assist politicians in the development of a better acoustic environment.

At INTER-NOISE 1987 in Beijing, China, Fritz Ingerslev, then president of I-INCE, unexpectedly asked me if it was possible to hold INTER-NOISE 1990 in Gothenburg, Sweden. After a couple of telephone calls to my department at Chalmers, dates for INTER-NOISE 1990 were set; the Gothenburg Concert Hall was booked for holding the opening ceremony; and necessary space at the university was booked. So the next day I could say yes, with pleasure, to Ingerslev and to Bill Lang, who at that time had succeeded Ingerslev as I-INCE president. That was the start of Bill's and my close cooperation through 30 years: in the organization of INTER-NOISE 1990, in our work on the board, as successive I-INCE presidents, in our work on noise policy, and so forth.

Bill often visited Sweden. Bill's wife was Swedish. Very shortly after the congress in Beijing, Bill came to Gothenburg for a couple of days to help us with preparations for INTER-NOISE 1990. Bill was an experienced congress organizer. He mastered most aspects of organizing a big congress, and was always prepared to get involved in such work. Bill also taught me a lot about the hotel business. We visited hotels in different categories, negotiating with them about prices, concessions for free rooms, etc.

Three years later we held a successful congress, which with 800 participants, turned out to be the biggest international congress to be held at that time at Chalmers. During these three years of preparation, Bill gave me a lot of advice.

In the late 1990s, there was discussion about whether noise is a local or global problem. At INTER-NOISE 1999 in Fort Lauderdale, there was a special session: Is noise a global policy

issue, or a local issue? Some persons working with international noise issues argued that noise was a local problem in which they did not like to be involved. Instead, it had to be dealt with on the municipal level.

But the main environmental noise problems were caused by industrial products manufactured and marketed globally, as well as consumer products, airplanes, and road vehicles. Municipalities have very little influence on the noise emissions from such products. The quieter world demands action on a global level. The big task is global noise policy, and we want to be involved. The policymakers need our support. We know the task is extremely complex. We must be well prepared to win policymakers' confidence.

What is the state of the art? Do we have the tools to bring about the quieter society? Is there a sufficient number of educated persons available? Is our knowledge sufficient so that suggested political goals are realistic? Such questions are important and lead the way to widen I-INCE's work so we can assure political bodies we are well prepared.

Answers to these questions led to the technology study groups, and also to several special sessions and workshops. Bill Lang initially developed the Technical Study Group (TSG) program in 1992. He proposed that I-INCE should set up such groups, whose reports aimed to give the facts on the state of the art in technology and science in different important fields. He compared them to standards that are the challenges for setting more ambitious goals. Also, seminars, workshops, and special sessions were the means to clarify the situation in different fields.

I-INCE has sponsored several such activities. The main results are assembled in reports and source books. Bill participated in several of these TSGs and many other workshops. His contributions secured the high quality of the publications. The TSG reports deal with noise limits in the workplace, noise emissions of road vehicles, factory regulations, etc. On Bill's initiatives, I-INCE sponsored one international workshop or symposium per year on a specialized noise control engineering topic.

Bill searched very actively for ways to reach the policymakers and get them informed about the best possible technology. We need collaboration with organizations with a clear mission to advise governments on policy issues. This led Bill first to the United Nations, which is the most general of such organizations.

Had the UN been successful in any similar issues? Could the UN's Tobacco Control Act be a model? Bill discussed this with one of the lawyers in the UN who had been involved in the development of that act but found it less suitable as a model in the noise space. The engineering academies might be better suited.

Furthermore, the engineering academies have the joint organization CAETS, which is an independent, nonpolitical, non-governmental international work organization of engineering and technological sciences. Its number one objective is to be prepared to advise governments and international organizations on technical and policy issues related to its areas of expertise. CAETS envisions a world in which national and international decision-making on economic, social, and environmental pursuits is properly informed by relevant engineering, scientific, and technological considerations. Today, CAETS represents 26 international academies, and holds annual meetings.

The secretariat is kept by the U.S. National Academy of Engineering, and the secretary for many years, until recently, was William Salmon of the U.S. In 1995, Bill had tried to get CAETS interested in taking up the noise issue. That year the council meeting was held in Kiruna,

in northern Sweden. The meeting's theme was "Creating Wealth in Harmony with the Environment."

Bill and I attended that meeting. Bill tried to get attention to the fact that noise is an important aspect of the environment. There was zero support from the other participants in the meeting that noise was an important environmental factor that concerned the academies. Twelve years later, in 2007, the CAETS convention was held in Tokyo, and the theme for the seminar was "Environment and Sustainable Growth." Bill suggested that he and I should attend the Tokyo convocation and make a new attempt to get noise on the agenda. I was invited to give a paper on noise. Its title was "Noise as a Constraining Factor in the 21st Century Urbanization." The paper was well received.

The next day, Bill Lang, in the council meeting, proposed that the issue be taken up on the CAETS agenda. The council gave its approval. The CAETS mission should be to promote policies leading to a less noisy environment. This was an important step forward.

Bill was very careful concerning how to proceed to keep high confidence. He laid the plans for the coming years. He always had a well-thought-out, long-term strategy. CAETS' involvement should start with an assessment of the noise situation in different areas by holding a series of workshops. The task was given to a study committee in the three CAETS workshops during the next three years: Southampton, 2008; Ottawa, 2009; and Lisbon, 2010. Comprehensive assessments of the noise control technology were made. The thoughts were assembled in three comprehensive source books. Bill took a very active role in organizing these forums and getting them well documented.

The Southampton workshop assessed current and future technology for the quieting of road, rail, and air transportation vehicles. The goal of the workshop was to identify and prepare an inventory of the technology attainable today for the design of low-noise vehicles and to assess needs for the development of future technology for the reduction of transportation noise. The report was presented to CAETS and the conclusion was that the scope of this study should be expanded to consider global technology in other areas besides transportation.

During the Ottawa forum the next year, we considered the technologies for many other stationary noise sources, including noise in buildings, as well as codes, practices, and standards for low-noise machinery and equipment. And the final forum in Lisbon covered China's challenging design requirements for low-noise products; the worldwide green agenda and product noise, technology, and public demands for a quieter world; and actions to be taken on the CAETS noise control technology assessment.

At the CAETS Council Meeting in Copenhagen in June 2010, it was decided to go from assessment of the noise problems to support of policymakers. The Noise Study Committee was renamed the CAETS Noise Control Technology Committee, NCTC. The CAETS committee as of mid-2011 had 19 members, from 10 of the 26 member academies of CAETS. The memorandum of understanding between I-INCE and CAETS concerning joint activities was approved in October 2010.

Much of our CAETS work since 2006 has been related to the road traffic noise problem, which is a major and very complex part of the environmental noise problem. Recent research in Europe documents the serious health effects of traffic noise. A CAETS forum in Innsbruck in 2013, titled "Quieter Cities of the Future," in which Bill was involved, gives a broad insight into problems and possibilities.

Technical requirements on road vehicles are handled by UNECE Working Party 29, a working party of the UN Economic Commission for Europe, which placed them in the "World

Forum for Harmonization for Vehicle Regulations." Working Party 29 has a working group, Group Rapporteur de Bruit, or GRB. The "B" stands for noise in French. This deals with exterior noise limits. GRB has no experts on the health effects of traffic noise and has not explicitly considered these effects in its deliberations.

The CAETS noise committee has followed up on this work. It has been clear that GRB has a limited understanding of the health effects of traffic noise and of its responsibility in the process for decreasing the health effects. Our opinion is that the present test method, with its limit values, is inadequate to really decrease the health effects of traffic noise.

Bill Lang understood that the CAETS NCTC committee greatly needs a seat at the GRB table in Geneva to be able to influence its decisions. He took necessary steps to get that seat. The GRB is open to government, experts from any UN member country, and representatives of accredited NGOs. To participate in the Working Party 29 and GRB meetings, an NGO must first be accredited in a consultative status through the Economic and Social Council of the UN. NCTC, through CAETS, applied for consultative status, including the UN Economic and Social Council, or ECOSOC. This includes UNECE WP 29 and GRB. The application was approved in August 2013, opening new possibilities for NCTC influence on global noise policy.

It could then—in 2013—be concluded that the CAETS NCTC project was active and could make a difference in the development of global noise policies. Bill's leadership during these years to establish and organize the work with CAETS, NCTC, and GRB had been extremely successful.

Bill Lang's ultimate goal I mentioned—a world in which quiet reigns, and quality of life is not diminished by noise—was very ambitious. This demands that the noise level limits on the world's dominant noise sources be reduced. The CAETS NCTC could make a difference in this work.

The future success of the CAETS NCTC in supporting policymakers in achieving a real change now depends on extensive support from the noise control engineering community. Only with that support can a balance with the lobbies from industry be established. We need actively-working members of NCTC.

We are grateful to William Lang for his long and devoted and skillful work for a substantially quieter world. Noise policy and noise reduction are complex issues. While the effects of Bill's work in terms of achieving noise reductions or radical new goals in our environments are so far limited, Bill has developed methods and paved ways. Bill sometimes said, "Even if we did not come as far as we'd hoped, we have had a lot of fun." Bill Lang loved working.

To this I would like to add a few personal words. For a couple of years, Bill spent a mid-summer week with my wife, Margareta, and me in our summer house on the Swedish west coast. There we established a very productive working committee dealing with global noise policy. We mixed creative work with long walks in the surroundings and Midsummer's Eve dances around the maypole. Thank you, Bill, for happy memories.

2.9 Bill Lang's Contributions to Noise Control Engineering in Japan

Hideki Tachibana—Professor Emeritus, Applied Acoustic Engineering, University of Tokyo

First, I'd like to express my sincere condolences over the passing of Bill Lang.

As was introduced in the previous presentation, Bill played the leading role in the operation of the International Institute of Noise Control Engineering—International INCE—since its establishment, and proposed the policies governing the activities of the institute. He contributed greatly to the current smooth running of the International INCE activities, including the annual meetings of INTER-NOISE congresses.

In this session, I'd like to briefly outline Bill's contribution to the field of noise control engineering in Japan. Bill set the stage for us to establish the Institute of Noise Control Engineering of Japan, INCE-Japan. In 1973 he suggested that the Acoustical Society of Japan, ASJ, host INTER-NOISE in Japan. In the wake of this proposal, the Noise Committee of the ASJ took the lead in convening INTER-NOISE 1975 in Sendai. This was the first INTER-NOISE congress held in the Asia-Pacific region, representing the thoughts of International INCE, led by Bill, of expanding the reach of INTER-NOISE to a global audience.

With this congress as a start, INCE-Japan was established in May 1976, mainly thanks to the efforts of noise experts among the ASJ members. In the background of this movement, there were serious environmental noise problems in Japan, such as noise from road traffic, express trains, and airplanes, and administrative measures were being discussed to address these problems. Bill greatly encouraged the establishment of INCE-Japan. Since then, different team representatives from Japan have been on the board of International INCE and participated in the operation of that institute.

Bill gave a total of three lectures in Japan. At the first one, in March 2004, Bill gave an important lecture titled “Progress of Noise Policy in Europe and the United States” at the lecture meeting co-hosted by INCE-Japan and the Ministry of the Environment, Japan. In this lecture, he outlined the discussion on noise policy in the United States and major European countries, which provided a great stimulus to noise control engineers and those who were responsible for noise policy in Japan.

At the second one, in March 2007, he gave a special lecture titled “Noise Control: An Engineering Discipline Whose Time has Come” to key members of the Engineering Academy of Japan. In this lecture, he described the importance of noise policy and emphasized the need to discuss the issue of environmental noise as a major topic in academic societies for the development of noise policy.

In September 2011, he and Professor Tor Kihlman jointly gave a lecture titled “Sound Environment as a Global Issue” at the special meeting related to INTER-NOISE 2011 in Osaka. They explained the history and significance of International INCE; its public activities, and especially its approach to the International Council of Academies of Engineering and Technological Sciences, CAETS; and the complementary relationship between noise emission regulations and noise emission guidelines.

Bill consistently stressed the importance of global noise policy in those lectures; namely, he insisted on the necessity of establishing a global noise policy from the perspective of engineering in order to address the problems of occupational noise, community noise, and consumer and industrial product noise. He seemed to be motivated by his experiences of engaging in the planning of noise policy in the United States in the 1970s, as typified by the Noise Control Act of 1972, and later by taking a leading role in the Technology for a Quieter

America and other programs. In order to actively promote this discussion, he also energetically led meetings and special sessions on global noise policy, and on Buy Quiet at International INCE.

Bill's accomplishments in planting seeds for discussions on global noise policy also deserve high praise. To deal with today's increasingly globalized and diversified transportation and logistics, the researchers, practitioners, and administrative workers who are involved in noise control engineering around the world must take into account the idea of global noise policy. Following Bill's lead, we must always keep in mind this idea of global noise policy and carry out continuous discussions on the issue.

On a personal note, Bill and I were co-conveners of the International INCE Technical Study Group No. 3, Noise Policies and Regulations, from 1999 to 2008. The purpose of this particular study group was to develop a survey of noise legislation in various countries around the world. Fortunately, with the cooperation of International INCE members from many countries, we successfully published the final report titled "Survey of Legislation, Regulation, and Guidelines for Control of Community Noise" in 2008.

I served as president of International INCE for five years, from 2004 to 2008, as the first president from the Asia-Pacific region. This was realized thanks to the three-geographical-region approach that Bill strongly promoted.

I remember him smiling, waving, and talking to me whenever I saw him at INTER-NOISE congresses and board meetings of International INCE. Figures 2.9-1 and 2.9-2 show Bill at INTER-NOISE 2007 in Istanbul and INTER-NOISE 2011 in Osaka. Lastly, I must express my deepest gratitude for Bill's leadership and help both officially and privately. Thank you.

Figure 2.9-1 *INTER-NOISE 2007 in Istanbul*

Figure 2.9-2 *INTER-NOISE 2011 in Osaka*

2.10 Bill Lang and I-INCE

Robert J. Bernhard—Vice President for Research, University of Notre Dame, and Board of Directors, INCE Foundation

I put my presentation last in this session so I could adapt it for points already made. It turns out, even with the wide range of Bill's accomplishments already discussed, I still have a lot to offer. I'm going to speak to Bill's contributions to the International Institute of Noise Control Engineering.

I'll start off with a little bit about my own personal relationship with Bill. I met Bill around 1986 when I was first elected to the Board of Directors of INCE-USA. At the time, I was a young assistant professor who was new at Purdue and pretty wet behind the ears. The Board of Directors consisted mostly of people who were in the founding group of INCE-USA, so I was sort of the first of the new generation. For many of those board members, it was "Uh-oh. What's going on here? We have a new person with—at the time—brown hair and so forth." But I always felt Bill was supportive. I felt he always looked at me as someone who would be the first wave of the next generation, and that he supported me in bringing things along. At that time in 1986, Bill had been active for almost 30 years. He was always a good mentor.

Over time, Bill sort of faded away from INCE-USA. George Maling was very active and was also a mentor to me on all things INCE-USA. Bill was largely outside of my world for a while, though I saw him at most congresses. Then, in 1999, he reappeared and twisted my arm to join the International INCE Board as vice president for Pan America. And I think that may have been the first time that position was filled. A year later, I became the secretary general and worked very closely with Bill from that time, on all matters I-INCE.

At the time of Bill's passing, those of us on the international board were talking a little bit about how we were going to remember Bill. I remarked how I had met Bill when I was young and so forth. Everybody else stepped back and said "You've known Bill longer than any of the rest of us have." It was true, but quite a shock. Even though Bill was 30 years into his career when I met him, I worked with him for 30 years. He had worked with many generations of noise control engineers, especially on fronts related to administrative matters. And, so, it's with great honor that I stand here to represent what we're doing in memory of Bill with respect to International INCE.

I'm going to organize my remarks around four themes:

- Bill was a founder of I-INCE;
- He helped build it;
- He led it; and
- After his period as a leader, he also was a sustainer and spent quite a bit of time after his presidency helping us to sustain it (Figure 2.10-1).

In terms of the founding of I-INCE, I have the benefit of having Bill's papers. About 10 years ago, he offered to pull together all of his papers associated with International INCE and transfer them to the INCE-USA archives, which I was holding at the time. A few years ago, I went and picked up those papers and brought them to my home so I could make some notes. Most of those archives consist of his correspondence through the years, from about 1971 through about 2002. I

was able to go back through those records and track some of the developments of how the founding of I-INCE evolved and look at some of Bill's interactions with the other founders.

I-INCE was very much a product of Bill's vision. That origin is a combination of the things that Bill was doing in his global network representing IBM and IEEE and his experiences with INCE-USA. A lot of his network was developed with the standards work that Bob Hellweg mentioned, where he was making connections with leadership around the world in different organizations talking about acoustics issues. Also, it was clear that the early days of INCE-USA—when there was success in forming the organization, beginning to hold conferences, and developing a vision—motivated Bill to think in terms of international activities. The huge success of INTER-NOISE 72, followed the year after by INTER-NOISE 73 in Copenhagen, also contributed to Bill's thinking that there should be some kind of an international organization dedicated to noise control engineering.

Bill mentions—I think in the Rich Peppin interview—that he invited Fritz Ingerslev to come to INTER-NOISE in 1972, and that support was provided for his trip. Apparently Professor Ingerslev was very taken with the congress, but it's hard to tell whether he was coerced or volunteered to host INTER-NOISE 73: According to Bill, Ingerslev volunteered. The decision was made relatively quickly after INTER-NOISE 72 that there would be an INTER-NOISE congress in Copenhagen, which was also a very successful meeting.

It was after that meeting that the idea was hatched that there should be an international organization. According to recollections from both Bill and George, it was Bill's idea that there be an organization of societies formed. There were some models for this. Bill started floating the idea with some of his colleagues in the U.S. and eventually talked to Ingerslev about his idea and whether or not they should move forward with it. By July of '74, they had decided they would move ahead with it, and so the bylaws and other paperwork were developed at a meeting in London in July of '74.

It is noteworthy that there was a relatively short timeline between INTER-NOISE 72, INTER-NOISE 73, and July of '74. The organization was announced in September of '74. It was registered in Switzerland on the 1st of October in '74. The first board meeting was held in Sendai, Japan, at INTER-NOISE 75. The original board was Ingerslev as president; Rathé as secretary/treasurer; Lang and Mattei as directors at large; and Crocker, Pedersen, and Johnson as directors associated with previous INTER-NOISE congresses. The format of the board from the early stages was to have directors at large and then directors associated with the international congresses. That was the founding of I-INCE.

In the early days—between 1975 and 1987, while Ingerslev served as president—Bill clearly was active in many ways. In the correspondence, I can see that there was a major effort to contact acoustical societies around the world, to ask them if they would join and to make the case for them to join. The first five members at the organization's founding were INCE-USA and the Acoustical Societies in Denmark, Norway, Japan, and Switzerland. A year later, there were five more, including the Acoustical Society of America; VDI; the South African and Australian Acoustical Institutes; and INCE-Japan. In the correspondence there is evidence of continual growth of the membership.

The correspondence in those days, of course, was being done by what we now call "snail mail." In the files you see a letter go out and you see a response come back two months later. Sometimes you see references to board meetings of these societies where they promise they'll respond in six months and so on. So it was a painstaking work. I think Bill and Ingerslev also

spent a lot of time at standards committees and other meetings talking to influential people in different societies and looking to help grow the institute.

By 1984, I see correspondence showing there were 23 member societies, with five sustaining members. There was also a record of outstanding inquiries to other societies about joining the institute. In 1984 there were 18 inquiries outstanding.

Besides membership, there was a lot of work on governance. From the records, it is apparent that Bill drafted the bylaws and some of the early governance documents. There was a lot of work to revise those in the early days of I-INCE. And a lot of work went into what I call the "regularization" of the INTER-NOISE management—sorting out how it would operate and so on.

Also early on there was a newsletter established. The minutes of early meetings show discussion about how to get material for the newsletters, and how to distribute the newsletters. It sounds familiar today, even 40 or 50 years later.

In 1988, Bill assumed the presidency, and for 12 years he served as president. This is another phase for I- INCE: In my view, the institute went from the growing phase to the maturing phase. By 1999, at the end of Bill's presidency, the institute had gone from 27 members to 42, with three observers. I think that number of members is similar today, although some members have changed. You see the board sort of opening up and some different board membership. The early membership looked a lot like the founders group, but by 1999, Bill had begun bringing other people onto the board. The credit balance was recorded in the minutes, and it moved from approximately $14,000 to $63,000. So the organization had some financial cushion.

One of Bill's big innovations was to start the I-INCE rules of operation as an addendum to the bylaws. The Rules address specific ways the institute would be governed. There were three sets of rules passed while Bill was president: Part 1, which is about the General Assembly; Part 2, which is about the Technical Study Groups; and Part 3 about the Congress Selection Committee.

Selection of the future congress venues prior to that time was done pretty informally by the Board of Directors. When Part 3 was passed, the committee began to involve a large group of people in making the congress selection decision. In the early days, there was a two-year cycle, with INTER-NOISE held in the U.S. or in the Pan-American region one year and internationally in the alternating year. By the end of Bill's presidency, it had moved to the three-year cycle that we follow now, with the meeting held in the Pan-American region one year, in the Europe-Africa region the second year, and then in the Asia-Pacific region the third year.

This is a picture during Bill's tenure (Figure 2.10-2). He was an ambassador for International INCE and went to a lot of meetings. This particular picture was given to me by Jean Tourret and it was just too good to pass up. Bill is in the little yellow highlighted circle, front and center. This was a structural acoustics conference that CETIM hosted around 1990. This was not Bill's technical expertise, but he was there advocating noise control engineering to a very elite group of acousticians. This is a who's-who of people working in structural dynamics, vibrations, and structural acoustics at the time. I remember being at that meeting. I also remember not being too enthused about taking a picture with a group this large. I can't find myself in this picture, so I'm not sure what happened.

Post-presidency, Bill did not fade away. He was very active. In the years after he served as president, he took an active role in mentoring the next set of I-INCE leaders. As we established three-year terms for offices, it was understood we would have to prepare people more

quickly and have people serving shorter terms. Bill was a part of helping to onboard new officers and directors and providing continuity.

In the 2005 to 2008 era, Bill was vice president for global noise policy, and began the work with Tor that Tor mentioned earlier related to noise control policy internationally. Eventually they settled on interacting with CAETS as Tor has documented. Bill was also a primary supporter of the Technology for a Quieter America effort undertaken in the U.S.

From 2009 to 2015, almost to his passing, Bill served as vice president for rules and governance. He was very conscientious and much-appreciated as a person who kept a watch over our rules, our governance, our bylaws, and so forth. When things were out of date, Bill was the person who identified necessary updates and came to the board with changes. From a detail perspective, we owe Bill a lot of credit for helping us keep our governance documents in line with what was practiced at the time. In 2016, he handed that job off to Dave Holger and became a distinguished board member. He was a board member until his passing.

I also grabbed this picture from 2011 (Figure 2.10-3) because there's a humorous story behind the scene. When we assembled on the stage, we had been told "Don't hit the keg because you might damage it. We've got another keg with the sake that we're going to pour." But Bill didn't hear that, so when they said, "three, two, one," he gave it a good lick. Fortunately, it didn't break and spill sake all over the floor!

I also wanted to mention Asta (Figure 2.10-4). The story's been told about their romance—how they eloped quickly and so forth. But I wanted to mention Asta because she was always at the INTER-NOISE congresses, and very much the first lady of International INCE. Especially with Bob Lang here, I wanted to mention that we really appreciated and loved having her with us.

That's my story of Bill—certainly a founder, a builder, a leader; and even after his term was done, a sustainer (Figure 2.10-5). He left one huge legacy here for us, and we're very appreciative. Thank you, Bill.

Figure 2.10-1 *Bill leading International INCE*

Figure 2.10-2 *Structural acoustics conference hosted by CETIM. Bill in circle, front and center*

Figure 2.10-3 *The Sake keg during the 2011 congress*

Figure 2.10-4 *Asta Lang— very much the first lady of International INCE*

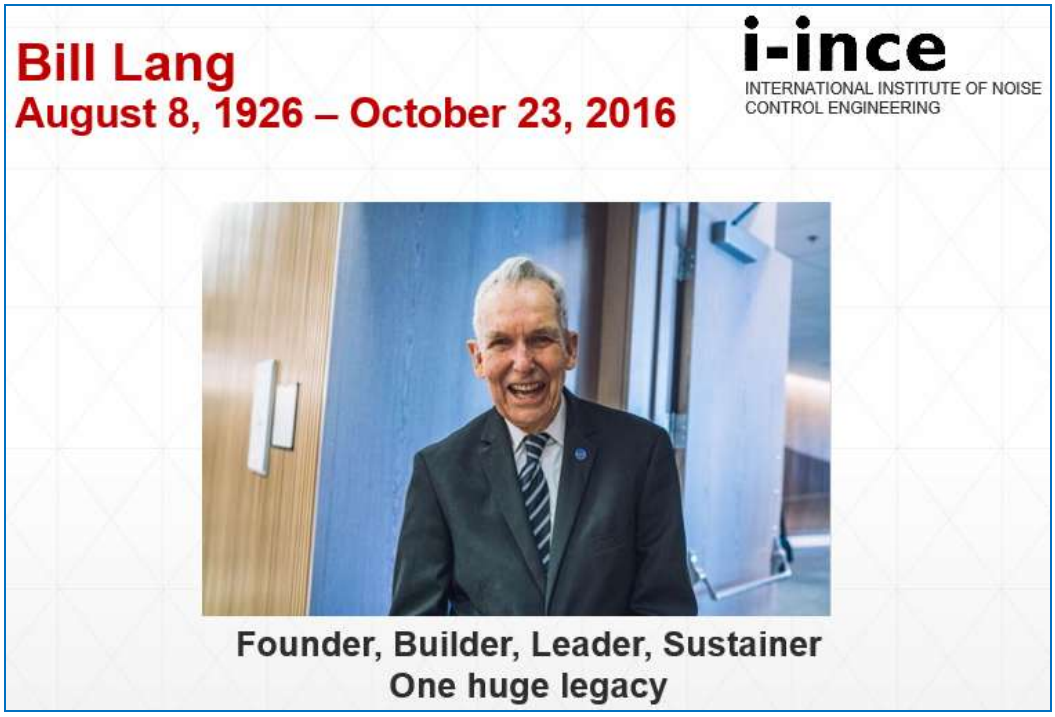


Figure 2.10-5 *Founder, builder, leader; and even after his term was done, a sustainer*

2.11 Bill Lang's Contributions in Noise Control—Additional Audience Remarks

David Lubman—DL Acoustics and Member, INCE and ASA
Truls Gjestland—SINTEF, Norway

David Lubman

Thank you and hello, everybody. My name is David Lubman, and I'm a member of INCE-USA and ASA. Bill was a perfect gentleman and he was an inspiration. I wanted to add some information about Bill's contribution to the work we're doing for ASA with the classroom acoustics standard. Another important contributor to this work was Lou Sutherland, our esteemed colleague who passed away a couple of years ago and is still sorely missed.

When Bill found out what we were doing with the classroom acoustics standard, which didn't involve International INCE, he was very enthusiastic in pushing us to promote the classroom acoustics standardization in other countries through International INCE. I was not part of the executive decision-making—I was just one of the "doers"—but I do remember organizing meetings with people in France, England, Italy, Turkey, I think Spain, and a number of other countries that I can't remember now. This was about encouraging the development of standards appropriate for their countries because there was a lack of uniformity.

I was amazed that we had a lot of success. There was real enthusiasm for this. And it was Bill Lang who had recognized this gap and who pushed us. I don't remember being paid for the international trips, but I was very proud of the good work that was done. And it seems to me, the only person I know whom I can hold responsible for this was Bill Lang. And I miss him.

Truls Gjestland

There is one thing about Bill that has not been mentioned here, and that's the way that he made you feel good. I think he was the first man inside I-INCE that recognized me and greeted me and made me feel a part of the community. That could be because I come from Norway and his association with Sweden. The same thing goes for not only Bill but Asta, too, and also George and Norah—the way they made I-INCE feel like a family thing. And that was something very special coming from nowhere and getting to this strange, frightening assembly. He made me feel good from the very beginning. Thank you.

2.12 Bill Lang and Friends at Conferences

Francis (Frank) Kirschner, a long-time friend of Bill Lang

Bill Lang and I were friends for a very long time. We first met at the 1953 International Conference on Acoustics (ICA) in Delft, the Netherlands. Bill would have been 27; Bill, Stig Ingemansson, and I were the youngest persons in attendance at the conference.

In subsequent years, I and other long-time friends would meet at various locations and at other conferences. When Bill's brother-in-law, Uno Ingard, left Chalmers in Sweden to come to MIT, he left Stig Ingemansson (Figures 2.12-1,-2, -3, and -4) in charge of acoustics. Stig later founded an acoustical consulting firm that became very well known in Europe and elsewhere. Fritz Ingerslev (Figure 2.12-4) also knew Bill for a long time. He was a professor at the Technical University of Denmark, and in later years became very involved in standards. As noted in the articles by Tor Kihlman, Bob Bernhard, and George Maling, Bill tapped Fritz to be the chair of the second INTER-NOISE in Denmark in 1973. Bill also served as chair of the Acoustical Society's Technical Committee on Noise, and Tony Embleton (Figure 2.12-2) followed him in that role. In 1970, Bill and Leo Beranek (Figure 2.12-2) met to discuss the idea of a new professional organization, which became INCE-USA.

(Note: All captions below are left to right.)

Figure 2.12-1 *Stig, Bill, and Frank*

Figure 2.12-2 *Tony, Bill, Leo, and Frank*

Figure 2.12-3 *Bill, Asta, Stig, and Frank*

Figure 2.12-4 *Fritz, Bill, Frank, and Stig*

Figure 2.12-5 *Bill, Asta, and Stig*

2.13 My Association with Bill Lang for More Than 40 Years

Janet Moss

My association with Bill Lang began in 1972 when he and George Maling were looking for someone to handle the secretarial work for the newly formed Noise Control Foundation. At that time I was a stay-at-home mom with two young sons and a third on the way. It was a perfect solution for me to provide a second income for my family.

Bill introduced me to the world of noise control, and I was hooked. He made me aware of the excess noise around me that I'd accepted as unavoidable but noise that was not necessary. I am not someone who needs to have the TV or radio on for background noise, and I embraced the idea of quieter surroundings.

When planning for INTER-NOISE 84 in Honolulu, Bill felt it would be helpful for me to go with him and handle many of the small details such as timing and registration during the conference. That was an exciting opportunity to become more involved. He trusted me to carry out these tasks, and subsequently gave me more opportunities to work with him on these conferences.

Bill organized sessions at both NOISE-CON and INTER-NOISE congresses for several decades and included me in the planning and running of these sessions. Because these congresses were held in various locations within the U.S. and worldwide, Bill made it possible for me to travel to many different countries that I would have been unable to see otherwise. This was an exciting time for me.

On a more personal level, Bill and I enjoyed socializing and having dinner. After his wife, Asta, died, Bill spent several months over the holidays alone. I called him to see how he was doing, and he said he was learning to cook for himself and invited me over to taste the results. This began a routine of getting together once a week to make dinner. He had a lovely home, and we would enjoy watching the wildlife while we cooked.

When spring came the following year, I introduced him to gardening. We turned over a sunny plot of ground next to his porch; and there we planted tomatoes, peppers, beans, and potatoes. He knew all about growing potatoes from his childhood in Toronto where his grandparents had a small potato farm. To this day, I still plant potatoes and tomatoes in Bill's little garden.

Bill also enjoyed feeding the birds and had feeders by the windows where he worked and by his kitchen window. I kept track of how many different birds we saw from his office window, and at last count there were 29. One day he noticed that some mice were chewing into the birdseed bag, and that began his love affair with Claude and Cookie—my daughter's cats. They would be loving companions to him for the rest of his life.

When my daughter had to move, she could not bring her cats with her and gave them to me. I already had three of my own, and they did not get along with the new cats. When Bill found that he had mice, he asked to adopt Claude. And Claude took care of the rodent problem. But he thought Claude might be lonesome, thus Cookie was welcomed into his household. One of his greatest fears was that the cats would outlive him, and his concern was that they be cared for. When I die, I want to come back as one of Bill's cats—they were spoiled rotten!

To sum up my years with Bill, they changed my life. I will be forever grateful to him for exposing me to experiences I otherwise would have missed. I will never forget the memories of

our travels all over the world, and I will never forget Bill. He was a great friend and mentor to me for more than 40 years.

APPENDIX

COPY OF PAPER PROVIDED BY BOB BERNHARD

Bill Lang and the International Institute of Noise Control Engineering

Robert J. Bernhard
University of Notre Dame
Notre Dame, IN USA 46556

1 INTRODUCTION

The passing of William (Bill) W. Lang has been cause for reflection and examination of Bill's many contributions across an array of important fronts. One of those, and the one where I had the most personal interaction with Bill, was with the International Institute of Noise Control Engineering (I-INCE). My personal memories have been significantly supplemented by access to the I-INCE Archives, which consist of much of the correspondence and notes of the early days of I-INCE from Bill and the first president of I-INCE, Fritz Ingerslev. It is from these records that I draw much of what I write in this paper. In addition to chronicling Bill's contributions to I-INCE, these records also tell an interesting story of the phases of formation, launch, and growth of an organization that ultimately has had a significant impact on the developed world. Perhaps some reader would be interested in taking up the task of digging deeper in the record to synthesize such lessons learned.

By way of introduction to my relationship with Bill, I first met and worked with Bill in connection with the INCE-USA Board of Directors starting in the mid 1980s. At the time, I was a newly graduated PhD with a tenure-track assistant professor position at Purdue University and I was relatively new to the noise control engineering community. I suspect I was elected to the board more to represent the strong noise control engineering program at Purdue than for my own contributions. Bill was almost 30 years my senior and very well established. We had one interesting connection: We were both alumni of Iowa State University. I found Bill to be an excellent mentor and colleague. He brought me onto the I-INCE Board in about 2000, first by nominating me to be the vice president for the Pan American region, and then by proposing my election as the secretary general. Overall, Bill and I worked together for 30 years.

2 THE FOUNDING OF THE INTERNATIONAL INSTITUTE OF NOISE CONTROL ENGINEERING

From the distance of many years, the founding of the International Institute of Noise Control Engineering (I-INCE) appears to be a confluence of Bill Lang's global network established through his representation of IBM at international standards meetings and technical conferences, the successful founding of INCE-USA in 1971, and the success of the early INTER-NOISE congresses in 1972, 1973, and 1974.

In his reflections in his AIP oral history interview with Rich Peppin about his career and the founding of I-INCE, Bill highlights the invitation of Fritz Ingerslev to INTER-NOISE 72, the first of the congress series [1] . As a result of that visit, Ingerslev invited INCE-USA to hold the second INTER-NOISE in

Europe. It was held in Copenhagen in July 1973. The idea of an international organization of societies was formulated there, although there is evidence that Bill had hatched the idea earlier and discussed it with various colleagues prior to the discussions in Copenhagen.

I-INCE was founded at a meeting in London on July 28, 1974. The organization was announced at the plenary session of INTER-NOISE 74 on Sept. 30, 1974. It was registered as a Swiss verein and established formally on Oct. 1, 1974. Early correspondence about I-INCE, before and after the formal establishment of the Institute, focused on many issues, but prominently on establishment of the bylaws and on the interaction of the nascent Institute and the International Commission on Acoustics, which had been established in 1951 as an international organization of societies and to which many of the prospective members of I-INCE already belonged.

The first board meeting was held on August 26, 1975, in Sendai, Japan, at the INTER-NOISE 75 congress. The original board of directors consisted of President F. Ingerslev, Secretary General E. Rathe, Directors-at-Large W. Lang and J. Mattei, and Directors representing the previous INTER-NOISE series: M. Crocker (72), J. Pederson (73) and J. Johnson (74). The business of the first meeting consisted primarily of discussion of membership growth, finances, changes to the bylaws, and congress planning for INTER-NOISE 76 and 77.

3 GROWING I-INCE

The early years of I-INCE were devoted to establishing the INTER-NOISE series, formalizing governance, and growing membership. The archives show the substantial work of Bill and Fritz Ingerslev in contacting their network of acousticians worldwide. In these days before the internet and email, these contacts occurred primarily through traditional mail. There is evidence, as well, of long delays as the acoustical societies deliberated about joining I-INCE. Bill and Fritz also note follow-up conversations and discussions at standards meetings and technical conferences.

I-INCE launched in 1975 with five members: the Institute of Noise Control Engineering-USA, the Danish Acoustical Society, the Acoustical Society of Norway, the Acoustical Society of Japan and the Swiss Acoustical Society (Schweizerische Gesellschaft fur Akustik). These five societies were joined in 1976 by five additional societies, the Acoustical Society of America, VDI Commission on Noise Reduction (VDI-Kommission Larmminderung), the South African Acoustics Institute, the Australian Acoustical Society, and the Institute of Noise Control Engineering of Japan. By 1984, the report of the state of affairs of I-INCE reports 23 member societies and five sustaining members. It also records contacts made to 18 additional technical societies. Solicitation of membership was carried largely by Fritz Ingerslev and Bill Lang, with occasional assistance from others.

Quite a bit of attention was paid during this period to governance. There are records of continual improvement of the bylaws, documentation of the responsibilities of officers and directors, and guidelines for how to host INTER-NOISE congresses. These efforts, initiated very early on by the I-INCE founders, continue today.

I-INCE also established a newsletter in its early days. Board minutes reflect considerable effort to solicit news from international correspondents and to adjust the content to the audience of noise control practitioners globally. In those early years, publication and distribution was also a frequent topic of discussion, as international mailings could be a logistical challenge and quite expensive.

4 I-INCE PRESIDENT

Bill served as president of I-INCE from 1988 to 1999. This period is marked by significant growth and formalization of I-INCE governance. Membership grew from 27 members in 1988 to 42 members and three observers in 1999. The board of directors grew from nine to 14 over this period, with the notable establishment of officer positions for technical initiatives and communications and the beginnings of the offices of the regional vice presidents. The credit balance grew from 620,000 BEF (approximately 14,000 USD) in 1988 to 2,800,000 BEF in 1999.

Notably, during Bill's tenure as president, the first I-INCE Rules of Operation were developed and approved. I-INCE Rules Part 1, I-INCE General Assembly, and I-INCE Rules Part 2, I-INCE Technical Study Groups, were approved in 1998. I-INCE Rules Part 3, I-INCE Congress Selection Committee, was approved in 1999. The I-INCE Rules complement the bylaws and have become a major and efficient element of the governance structure for I-INCE.

During Bill's presidency, the major activity of I-INCE, the INTER-NOISE congress series, also grew substantially and moved from a cycle where the congress was held every second year in the U.S. to a cycle where the congress rotates on a three-year cycle between the Pan American region, the Europe-Africa region, and the Asia-Pacific region. The new rotation achieved increased exposure for I-INCE internationally and greater participation in its meetings.

5 POST-PRESIDENCY

Following his I-INCE presidency, Bill served as past president from 2000 to 2003, vice president for global noise policy from 2005 to 2008, and vice president for rules and governance from 2009 to 2015. He served as a distinguished board member in 2016, the year of his passing.

Almost from the beginning of his post-president tenure, Bill assumed the role of "parliamentarian" of the organization. He was the board resource for governance issues. And particularly as a new generation of officers and directors was elected to the board, Bill served as the primary bridge reaching back to the founding of the organization and organizational memory relating to policy and purpose. Often, as a result of his awareness that policies needed to be updated or that current practice did not match written policy, Bill volunteered to update and rewrite the I-INCE Rules of Operation and bylaws. Almost every meeting of the board included a proposed update or new policy. Without Bill's leadership in this area, it is hard to imagine how I-INCE practice and policy would be in its current good state of alignment.

Bill also devoted considerable energy to global noise policy. His history dating back to standards work, his involvement with the development of the U.S. Noise Control Act of 1972, and his roles in other international noise control policy deliberations gave him more insight than many other noise control engineering practitioners of the merits of activity relating to informing and advocating for policy. His awareness was also enhanced by his observation of the extensive impact and role of the U.S. National Academy of Engineering, to which he was elected in 1978.

Bill took on a large role on the I-INCE board of directors throughout his tenure, but with a formal designation as vice president of global noise policy over the period from 2004 to 2008, his efforts focused on amplifying the voice of I-INCE in the policy community as an advocate for a quieter world. While he was a willing ambassador for noise control engineering in any venue, the focus of his efforts to affect global noise policy was to engage international national engineering academies. To do so, he and Tor Kihlman engaged the International Council of Academies of Engineering and Technological Sciences, Inc. (CAETS). A comprehensive summary of the effort is included as an attachment to the 2012 board of directors minutes. The effort with CAETS started at its convocation in 2007. In 2010, CAETS established a Noise Control Technology Committee (NCTC) for the purpose of providing science-based support for policy makers on technological options for a quieter world. A summary of NCTC activities and symposia appears, as of this writing, on the CAETS website, at CAETS http://www.caets.org/cms/7123/9996.aspx.

In another effort, Bill contributed to the funding for the National Academy of Engineering's "Technology for a Quieter America" project. The effort, led by George Maling, Eric Wood, and others, has been a huge undertaking to convene discussions about various noise control challenges. The original 14-member committee produced a *Technology for a Quieter America* report in 2010 that was published by the National Academies Press. It explored four themes: noise control engineering and public concerns; applications of current technologies; research and development initiatives; and intra-governmental and public relations programs. Publication of the report was followed by six workshops in the period 2012 to 2017. A seventh workshop, on noise from unmanned aerial vehicles, will be held in 2018. Details and reports from past workshops are available on the INCE-USA website at https://inceusa.org/publications/technology-for-a-quieter-america/.

6 CONCLUSIONS

I closed my memorial to Bill Lang at INTER-NOISE 2017 in Hong Kong by characterizing Bill as a founder, builder, leader, and sustainer. These were not idle words. Bill's thinking and energy were central to the idea of I-INCE. If not *the* only founder, he was certainly the principal founder. Bill and Fritz Ingerslev were the champions of I-INCE from its birth to adolescence. Bill took over as president in 1988 and grew I-INCE into a mature organization with the requisite formality, as well as the inclusiveness, to expend far beyond the founders' influence. And Bill spent the last 15 years of his life supplementing the new generation of leaders and filling gaps wherever they existed. His contributions were enormous and selfless, enduring, and wise.

7 ACKNOWLEDGEMENTS

This paper above all acknowledges the many important contributions of Bill Lang to the founding and building of I-INCE. In addition, the author wishes to acknowledge the historical record of the I-INCE Archives, some of which has been uploaded to the I-INCE website, and particularly the papers of Bill Lang and Fritz Ingerslev. The author also wishes to thank George Maling for his helpful comments on early drafts of this paper.

8 REFERENCES

1. Bill Lang and Rich Peppin, AIP Oral Histories https://www.aip.org/history-programs/niels-bohr-library/oral-histories/29970.
2. William W. Lang, various correspondence, I-INCE archive.
3. Fritz Ingerslev, various correspondence, I-INCE archives.
4. "I/INCE, First Meeting of the Board", Sendai, 26 August 1975, I-INCE Archives.

Clockwise: Janet, Bill, Norah, and George