

women in engineering

MAGAZINE



Jolene Destefano: Pyrotechnician

Joyce Weisbecker: The First Indie Game Developer

**The Great Animal Orchestra:
Dr. Bernie Krause**



the first was meeting with a young Buzz Aldrin to provide career advice (Winston suggested that Buzz, the second man to ever walk on the moon, become an astronaut!). The other, closer to home, was inviting a Tufts professor he knew to get involved in IEEE and WIE activities and take a leadership role. That woman was Dr. Karen Panetta, past chair and editor-in-chief of *IEEE Women in Engineering Magazine*! Since then, Panetta has gone on to play an important role in IEEE and elsewhere. Winston, who attended WIE management meetings for the next two years to assist with planning and operations says, “The rest is history.”

Nihad Dib and Loay Tamimi were unavailable for this article. Congratulations to them and to all these Extraordinary Men!

—Leslie Zucker

A Prolific Innovator

Dr. Helena Wisniewski

Dr. Helena Wisniewski's father was an engineer who worked on the Viking Mars Landing—his patented actuator was on the landing vehicle—and her mother was a kindergarten teacher. Every Sunday, her grandfather used to arrive at her house with puzzles for her to solve, each one harder than the last, and he delighted in seeing her master them. In high school, she would pick up her father's engineering books and apply them to her own coursework. She had a passion and an aptitude for math, and she would go on to study mathematics at William Paterson University, where she became a distinguished alumna, and Stevens Institute of Technology before receiving her Ph.D. degree in mathematics from the Graduate Center of the City University of New York.

Wisniewski chose to study mathematics because she was particularly interested in the application of math to other

fields, including science, technology, and engineering. Early in her career, she often found herself defending the usefulness of mathematics and the necessity for pure research, but over the years her groundbreaking work has led to technological advancements, particularly in the area of artificial intelligence (AI).

A tech entrepreneur who has founded multiple start-ups and transformed more than one university into an innovation hub, Wisniewski was inducted into the National Academy of Inventors (NAI) in 2017 in recognition of her contributions to society. She has proven that mathematics is not only useful and necessary, but that it can be the gateway to many opportunities.

Pure Research

Wisniewski began her career in academia at Seton Hall University as an assistant professor and within a year became chair of the Computer and Decision Sciences department, where she created a Master of Science program in computer science. She also served as director of the Research Division at the Stillman School of Business. She left Seton Hall for the U.S. Central Intelligence Agency (CIA) upon learning that they hired mathematicians and that they were interested in the work she was doing. The CIA, Wisniewski recounts, would be the first place where she was able to apply her mathematical skills.

She was then recruited by DARPA to start and manage their first mathematics program; this would be a pivotal point in her career. At DARPA, as manager of the Applied and Computational Mathematics Program, she initiated and directed many advances in math, science, and engineering. She pioneered advances in AI and neural networks, championed AI, and created first-of-their-kind collaborations between universities, researchers in industry, and government entities.

In those early days, she faced a significant challenge at DARPA: convincing colleagues of the importance of mathematics. Why, some people wondered,

devote time and money to mathematics research—what is it good for? Those around her, Wisniewski realized, weren't aware that the advances in science, engineering, and technology that they were envisioning relied on this early, foundational work.

Recognizing that she needed to market her program's work to show the significant role that it played in all advances, she began to focus on publicity, holding annual meetings that became very popular, where “everyone would come and learn about the program's achievements and applications and the significance of mathematics and science.” She handed out brochures that described the program's work, including chaos theory, computational fluid dynamics (CFD), image compression, and AI that drew connections from the mathematics work being done at DARPA to the applications that the U.S. Department of Defense (DOD) was seeing.

In the brochures, she highlighted advances that evolved from her program's research, including the development of an algorithm that would ultimately be utilized on submarines for antisubmarine warfare, a breakthrough in image compression using fractals that achieved unprecedented compression ratios, and groundbreaking methods for aircraft design, such as the research that led to the first method to measure transonic flow over an entire aircraft taking into account complex geometries in contrast to calculating flow over separate portions and piecing them together, which led to errors at the edges.

It wasn't long before the office of the Chairman of the Joint Chiefs of Staff approached Wisniewski. They heard about her brochures and requested copies of them. At the time, the DOD was using Lanchester's laws, linear mathematical formulae for calculating the relative strengths of military forces. But war is not linear; instead, it can be chaotic. Because the DARPA math program developed algorithms to describe chaotic behavior, the Office of the Chairman of the Joint



Dr. Helena Wisniewski

Chiefs provided funding for models of war that included chaotic behavior.

“When I started the math program, I always received the question of what was math good for? Why are you starting a program in that area?” Wisniewski recalls. “I was able to prove why math was important.”

Learning the Business

After years at DARPA, Wisniewski was eager to try industry. The Lockheed Corporation recruited her to their corporate offices across the country in California. This was a groundbreaking role: as director of Advanced Computer and Software Applications, Wisniewski was among the first females to hold such an executive-level position at Lockheed. The fact that she was a mathematician at an executive level also “piqued the interest of many employees.” At corporate headquarters, she had the ability to work across the entire organization, access that gave her great insights into the running of the corporation, and she led the development of new interdisciplinary technology thrusts across operating companies. While at Lockheed she was able to develop the business acumen that would soon contribute to making her a successful entrepreneur.

She moved back to the east coast to become a vice president of the Titan

Corporation, where she “created new business initiatives and developed corporatewide strategic plans for technology development.” She reported to cofounder Albert E. Knauf, who had started Titan in his house before growing it into a billion dollar corporation. He would go on to play an important role in mentoring her throughout her career.

After Titan, she moved to Analytic Services, Inc. (ANSER), where she was vice president of IT. ANSER was a nonprofit federally funded R&D center and Wisniewski oversaw business operations and government contracts; was responsible for business growth, profit, and loss; developed and implemented strategic planning; and managed a complex organization in diverse technological areas. It was while she was at ANSER that she initiated and directed the development of a system that incorporated facial recognition, AI, and an aging algorithm to find missing and exploited children on the Internet and reunite them with their families. She secured US\$8 million in funding to support the development of this technology, and the first implementation was used by the West Virginia State Police, the U.S. Drug Enforcement Administration, and U.S. Customs and Border Protection.

When Senator John McCain invited her to give testimony to the U.S. Senate

Committee on Commerce and Transportation to discuss emerging technologies in the millennium, she talked about AI and facial recognition. When she was asked why it was worthwhile to fund pure research, this system is the example she gave. While at DARPA, Wisniewski directed development in the field of CFD, a branch of fluid mechanics that uses data structures and mathematical modeling to study and simulate fluid flows. However, this work in CFD led to an unexpected technology: it led to mathematicians funded by her program developing the facial recognition method that Wisniewski would later use at ANSER to find missing children and reunite them with their families.

Soon Wisniewski began to see the need for mass market, turnkey biometric systems and she decided to launch her first start-up, Aurora Biometrics, a facial recognition company that combined her knowledge of AI and biometrics. “I founded the company to provide complete turnkey biometric systems that automatically grant or deny access to facilities, networks, and e-transactions, PCs without PINs or passwords, to enhance security and prevent unauthorized access,” she says. Aurora’s products were based on her innovative mathematical methods.

Titan’s Knauf played a significant role in the company: he was her first investor and served on the board. “When I started Aurora, he was my mentor and he taught me the aspects of starting a company: from how do you value a start-up, how do you acquire funding, to constructing a business plan so people care, to creating a one pager for marketing; all these aspects you need to be successful,” Wisniewski says. And Aurora Biometrics was very successful, selling to businesses, government, and industry.

A Heart for Education

Wisniewski knew her heart belonged in education, though. She grew Aurora, sold it, and then returned to her alma mater, Stevens Institute of Technology, as vice president for research and enterprise development. There, she tripled research revenues, launched nine start-ups, and sold two. She championed the



Wisniewski, with Dr. Paul Sandberg, president of the NAI (left), and Drew Hirschfeld, former Acting Deputy Under Secretary of Commerce for Intellectual Property and Acting Deputy Director the United States Patent and Trademark Office, at her induction into the NAI.

technogenesis process, Stevens's tech transfer model that begins with research breakthroughs and ends with a commercially viable product, all through an emphasis on interdisciplinary research across the school as well as through university-industry-government collaboration. Under her leadership, increasing research revenues contributed to a 10-position increase in the *U.S. News & World Report* rankings to 71.

A number of the start-ups Wisniewski oversaw originated from undergraduate students with impressive senior design projects. One group worked with a physician in New York City who could determine which muscle was causing back pain using his hands. Back pain is tricky to diagnose: some muscles are overlooked and some surgeries are unnecessary. The physician asked the students to develop a technology that could perform that same function. They created the device, named *SPOC*, as proof of concept, and Wisniewski suggested they start a company. She helped them form a limited liability company and obtain funding.

The students raised millions from venture capital firm Connecticut Innovations. They hired fellow students and received national recognition when they were asked to appear on the morning show *Good Morning America*. Wisniewski's main advice one week before their appearance? She suggested that they file a provisional patent before the nationwide broadcast.

While at Stevens, Wisniewski was interviewed by a local newspaper that mentioned how she discovered that biometrics could be used to create dolls that would "recognize" their owners. She had achieved her goals at Stevens and so, inspired by her young daughter, she founded Equinox Toys in 2009 to incorporate this type of interactivity into toys, games, and dolls. She raised funding, prototyped the doll, and gained interest from toy manufacturers.

Soon thereafter, in 2011, a colleague at the University of Alaska (UAA) suggested she apply for the position of vice provost for research and graduate studies and dean of the graduate school at UAA. After visiting, she knew she could have

an impact there. "I saw a lot of potential at the university, but no one was marketing and getting the word out about their capabilities," she says. She set out to "build a culture to embrace research, creative works, and innovation."

Wisniewski set up a robust extramural grant and contracts program that significantly increased external grant-funded research expenditures over 37% from fiscal year 2011 to 2018, and put a commercialization structure in place that helped to dramatically increase patents and patent filings at the university, and together with faculty, she formed UAA's first start-ups and identified and negotiated investments. One such venture, Rhizoform, a biodegradable insulation that is a potential replacement for Styrofoam, won a national award for best university start-up. Another, CFT Solutions, later Arctic Heat, used carbon fiber tapes to heat surfaces, helping make them snow and ice free. This product was installed with great reviews and Wisniewski acquired funding from the Alyeska Accelerator fund for the company.

She started a Patent Wall of Fame to recognize achievement and inspire more innovation. She also established the Innovate Awards to inspire and support research, scholarship, creative works, and innovation. These awards provided funding to launch critical endeavors—and interdisciplinary collaborations—across disciplines, resulting in a six-to-one financial return on research investment through external grants acquired by award recipients and were also the basis for start-ups. Faculty have gained international recognition for their work supported by the Innovate Awards.

Most significantly, she created the Arctic Domain Awareness Center (ADAC) to "develop and transition technology solutions, innovative products, and educational programs to improve situational awareness and crisis-response

capabilities related to maritime challenges posed by the dynamic Arctic environment." She gathered a large team for multiple departments at UAA and partners across the United States and Canada in industry, universities, research institutions, and the Alaskan native community, and she

led the effort that won a nationally competitive multiyear award for US\$16 million from the U.S. Department of Homeland Security (DHS) for ADAC, making UAA the first and only institution in Alaska to lead one of the DHS Centers of Excellence. "It proved there was a lot of talent and gained national recognition for the university," Wisniewski says.

She is currently a tenured professor of entrepreneurship and chair of the Management, Marketing, Logistics, and Business Analytics department. "Understanding the importance of AI and data science to enrich students' university experience and prepare them for careers as future leaders and decision makers," Wisniewski created the first College of Business and Public Policy (CBPP) AI course, "AI with Business Applications," and instituted the AI webinar series across multiple disciplines with nationally renowned speakers. She established UAA Membership in the Digital Twins Consortium and established the Alaska Data Science and AI Lab (ADSAIL) in collaboration with the College of Engineering and McKinley Management. ADSAIL provides a collaborative, multidisciplinary environment for students and faculty to solve AI challenges with industry partners while training future data scientists and AI researchers. She is also the editor of *AI Education*, a new technology and innovation journal of the NAI. She currently has a contract to write her second book, "Global Supply Chain Management With Emerging Technologies," from World Scientific.

She strongly believes "that entrepreneurs are important to the global

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economy and drive innovation.” So, she continues to nurture entrepreneurship through programs and certificates and organizes the CBPP business plan competitions to foster aspiring entrepreneurs at UAA and within the community. The students in her entrepreneurship class compete and have won prizes, providing a nice extension beyond classroom learning. To promote an inspiring experience, she created the competition to include mentoring sessions with judges and events for networking, selecting judges comprising executives, entrepreneurs, and partners in venture firms. She also coauthored “Academic Entrepreneurship,” published by World Scientific, which is used in courses at UAA.

A Prolific Innovator

Throughout her career, Wisniewski has served on public and private boards of directors, including Greatbatch, a company that develops implantable medical

devices. This company patented the first implantable pacemaker. In addition, the U.S. Secretary of the Navy appointed her to serve on NRAC. She was invited by IBM to be the Distinguished Speaker at their Distinguished Speaker webinar in July 2022, where she presented “The Convergence of Emerging Technologies With AI—Global Impact.”

One of the most meaningful awards for Wisniewski was given in 2017 when she became a fellow of the Academy of Inventors. This award is in recognition of “academic inventors who have demonstrated a prolific spirit of innovation in creating or facilitating outstanding inventions that have made a tangible impact on quality of life, economic development and the welfare of society.”

She has received awards for noteworthy contributions to advancements in scientific research and technology, outstanding leadership, entrepreneurship, and teaching. Among her awards are the

Rotary Vocational Service Award, 2022 Innovator Award, Graduate Teacher of the Year, the 2001 Women in Technology Award for Entrepreneurship, and Distinguished Alum—William Paterson University.

Wisniewski’s advice is to not let others “pigeonhole you in a category.” People have been surprised that as a mathematician she has held executive positions and has succeeded as a technology entrepreneur, but math, she says, has “opened a lot of doors.” Her advice is to follow what you really believe in. “What’s the real fire inside of you? What do you feel strongly about?” she asks. “To be successful you must have that fire and a commitment. You may face a lot of challenges, but with a strong belief in what you are doing, you will turn those challenges into successes.”

—Katie Williams



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