Technology and Innovation, Vol. 21, pp.75-84, 2019

ISSN 1949-8241 • E-ISSN 1949-825X
http://dx.doi.org/10.21300/21.1.2019.75
www.technologyandinnovation.org

QUEEN ELIZABETH PRIZE FOR ENGINEERING HONORS THREE NAI FELLOWS FOR INNOVATIONS THAT CHANGED THE WORLD

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When the Queen Elizabeth Prize for Engineering (QEPrize) was established in 2011, its goals were nothing short of recognizing individuals whose contributions to engineering have changed the world in lasting ways. Three NAI Fellows have since been honored among the recipients of what is now known as the largest engineering prize in the world, with an award of £1 million presented biennially. This article provides a brief retrospective of the QEPrize, profiles the three NAI Fellows awarded this rare international distinction, and offers some contemporary thoughts about the power of recognition to inspire future generations of innovators.

Key words: Queen Elizabeth Prize; Vinton Cerf; Eric Fossum; Robert Langer; National Academy of Inventors; Innovation; Engineering

INTRODUCTION

This is not simply a prize. This is a recognition of everything that engineering is and everything that engineering can and will become (1).

When Dartmouth professor Eric Fossum received the Queen Elizabeth Prize for Engineering (QEPrize) in 2017, he became the third NAI Fellow to be recognized by the world's top prize in engineering. Established in 2011 and first awarded in 2013, the QEPrize is the largest engineering prize in the world, with an award of £1 million presented biennially (2) to engineers who have made "an outstanding advance in engineering that has created significant benefit to humanity" (3). Fossum (NAI Charter Fellow 2012), professor in the Thayer School of Engineering at Dartmouth College, along with three other scientists, was recognized for his development of the CMOS (complementary metal oxide semiconductor) image sensor, which has revolutionized digital imaging and laid the foundation for the tiny cameras used in cell phones, computers, vehicles, medical instruments, and other devices (4). Robert Langer (NAI Charter Fellow 2012) received the prize in 2015, with the distinction of being the sole recipient that year. His citation recognized his pioneering innovations in controlled drug delivery—for diseases including cancer and mental illness—which have improved the lives of more than two billion people around the world (5). Vinton Cerf (NAI Fellow 2013) received the inaugural QEPrize in 2013, along with four other inventors, for fundamental contributions to the development of the Internet and the World Wide Web (6). This article provides a brief retrospective of the QEPrize, profiles the three NAI Fellows awarded this rare international distinction, and offers some contemporary thoughts about the power of recognition to inspire future generations of innovators.

Accepted: February 1, 2019.
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THE QUEEN ELIZABETH PRIZE IN ENGINEERING: "THE MISSING NOBEL"

In 2011, the Royal Academy of Engineering in the United Kingdom announced a bold initiative for a radically new type of scientific award. This award would be the first international prize to recognize engineers whose inventions and innovations have literally changed the world and had a positive impact on humanity (3). Founders hoped this award would carry prestige equivalent to the Nobel Prize, with the largest monetary prize ever for an engineering award (2). Additional goals for this new prize included recognizing interdisciplinary connections and collaborations as well as providing inspiration to encourage young people to enter the field of engineering (2).

According to the Royal Academy of Engineering, the creation of the prize was "the result of a growing realisation in the worlds of business, engineering and policy of the need for a pioneering initiative based in the UK to focus attention on engineering worldwide. …The prize will provide a high-profile, global communications platform to explore the breadth, creativity and impact of engineering of all kinds around the world" (3).

"This is about honoring excellence in order to inspire others to be excellent…It is, I think, righting [the] wrong in that there is no recognition on a global basis for engineering, and this is the recognition," stated Lord Browne of Madingley (7).

When the Nobel Prizes were established by Alfred Nobel in 1895, none of the awards specifically identified engineering (8). A category for Economic Sciences was added in 1968, but today, more than a century following the award of the first Nobel Prize in 1901, engineering remains absent from the field (8). Hervey explained that while "every now and again a technologist does sneak in, usually in the physics category…the exception however, proves the rule. Over the awards' history, they've been given to 881 people, only 28 of whom have been engineers or technologists" (9).

The QEPrize founders hoped to bridge that gap. As Lord Browne described, "We're taking the first step along that road. We're inviting nominations for a new kind of international engineering prize, one that will consider achievements from fashion to fusion and from telescopes to televisions" (1).

The QEPrize founders set the bar high, looking not only for a single invention "but an outstanding advance in engineering that has proved of global benefit to humanity" (10). Funding for the extraordinary £1 million award is provided by corporate donations to an independent charitable trust—the Queen Elizabeth Prize for Engineering Foundation (11). The trust delivers the prize, and recipients receive a specially designed trophy at a ceremony held in Buckingham Palace (10). Her Majesty, Queen Elizabeth II, and His Royal Highness, Prince Charles, have personally attended (10).

Dr. N.R. Narayana Murthy, founder of Infosys, and a member of the initial panel of judges for the inaugural prize, explained, "[T]he objective [was] to create a platform of recognition for engineering that has immense impact on humankind. The other objective [was] to make sure that engineering remains an attractive proposition for young people" (12).

However, the process of creating a single vehicle to merge the recognition of historic achievement with a platform to engage and inspire new generations became, in itself, a process of innovation. Professor Lord (Alec) Broers led the initiative as the chair of judges for the inaugural QEPrize (10,13,14). A scientist and researcher with an international reputation for catalyzing technology transfer from academia, Broers served as Vice Chancellor, University of Cambridge; president of the Royal Academy of Engineering; chair of the House of Lords Science and Technology Select Committee; IBM Fellow at the Thomas J. Watson Research Center in New York; and member of the National Academy of Engineering, who helped identify the 14 Grand Challenges for Engineering (10,13,14).

"The purpose of this prize—and it will be a gradual process—is to educate people about what modern engineering is," he explained. "So, by identifying an accomplishment that people can see as being of massive impact, [we can] say: 'Engineers did that; that's an exciting thing to do'" (15).

THE INAUGURAL PRIZE

Judges for the inaugural prize faced a dual challenge—selecting one single achievement from the innumerable array of contemporary engineering

advances that would simultaneously meet the goals of the new award and establish the standard for future awards.

"Part of the QEPrize, the brief for the judges, was to choose an engineering achievement that is demonstrably already affecting the world," said Professor Brian Cox, faculty at the University of Manchester and member of the inaugural judging panel (16).

Initial announcements about the QEPrize indicated up to three engineers would receive the inaugural award. The 2013 QEPrize ultimately recognized five individuals who were key in the creation and evolution of the Internet and the World Wide Web (5).

"I think it's difficult to identify an innovation that has had a greater impact on the world than the World Wide Web and the Internet. Here is an innovation that affects at least a third of the population of the entire planet," said Caltech Professor Frances Arnold (NAI Fellow 2014), another member of the inaugural judging panel (16).

> The official inaugural announcement read:
> The Internet and the Web: both have revolutionised the way we communicate and enabled the creation of whole new industries. Robert Kahn, Vinton Cerf and Louis Pouzin made seminal contributions to the protocols that together make up the fundamental architecture of the Internet. Tim Berners-Lee created the World Wide Web and vastly extended the use of the Internet beyond email and file transfer. Marc Andreessen, while a student and working with colleagues, wrote the Mosaic browser, which made the Web accessible to anyone. (5)

"Serving as judge for this unparalleled prize has been a great honor and one of the highlights of my career—I have met wonderful, creative engineers, and I have even met the Queen, who graciously awards the prize in person," Arnold added. "Choosing the first three prizes was not difficult because these inventions have touched so many lives. They have truly changed the world, and there are more to come."

VINTON CERF: A FATHER OF THE INTERNET (17)

At the end of his acceptance speech for the 2013 QEPrize, which he delivered via remote Internet connection, Cerf famously quipped, "It's like waking up from an exciting dream to discover the geeks are winning" (18). He also humbly deferred credit for his innovation, expressing that "literally millions have contributed to what you see today" (18).

Sir Tim Berners-Lee, a co-recipient of the 2013 QEPrize, stated, "Vint's great success was to make the Internet a platform that is usable for all kinds of future technologies, without trying to second-guess what they might be. Thanks to this approach, I was able to design the Web on top of the Internet because it was a strong but plain foundation for things to come" (17).

That foundation began with Cerf and Robert Kahn co-inventing the Transmission Control Protocol/Internet Protocol (more commonly TCP/IP) in the early 1970s for the ARPANET—the Advanced Research Projects Agency Network, led by the U.S. Defense Advanced Research Projects Agency (DARPA), and widely known as the forerunner of the Internet (19). Since that time, Cerf's inspiration and motivation to create a publicly accessible communications platform has evolved into a lifelong mission to maintain the accessibility, and improve the security, of the Internet (20).

In 1986, Cerf joined his co-inventor, Kahn, at a new non-profit corporation Kahn had founded—the Corporation for National Research Initiatives—which had the mission of providing research and development at the "frontier of Internet technology" (21). He later became the founding president of the Internet Society in 1992, and from 2000 to 2007, he served as chair of ICANN—the Internet Corporation for Assigned Names and Numbers (22). In 2005, he joined Google, Inc., as vice president, with a working title of "chief Internet evangelist" (19,23).

Cerf continues to actively contribute to public policy discussions about Internet privacy and security and has served on numerous boards and advisory committees, including the U.S. Presidential Information Technology Advisory Committee and the National Science Board, among others, and is frequently quoted in the news media on current issues (23).

Prior to receiving the QEPrize, Cerf had already been recognized with many high honors, nationally

and internationally, including the National Medal of Technology, the Presidential Medal of Freedom, and the Charles Stark Draper award from the National Academy of Engineering, among many others (22). He is a member of the National Academy of Engineering; a Fellow of many of the most prestigious academic organizations in the world, including the Institute of Electrical and Electronics Engineers (IEEE), Association for Computing Machinery, the British Computer Society, and American Association for the Advancement of Science (AAAS); and an inductee of the National Inventors Hall of Fame (22). In addition, he is a Foreign Member of the British Royal Society and was also named one of *People* magazine's "25 Most Intriguing People" of 1994 (22).

Sir Tim Berners-Lee once said of Cerf, "As a person, Vint has been not only an engineer but a leader. He has tried to ensure that both the Net and the community of developers evolve in a healthy way. This means both sound engineering and a positive impact on society" (17).

Cerf, however, indicated he never conceived how far the Internet would progress from his original invention. "[People] see the Internet now and think, well, … years ago someone imagined what it would look like [today], and that is what drove the process. It wasn't like that at all," remembered Cerf (23). He described it as an experiment that never ended (24), and he continues to look forward, toward the next advancement, noting, "I'd like to know what the Internet is going to look like in 2050. Thinking about it makes me wish I were eight years old [again]" (23).

ROBERT LANGER: VISIONARY AND RELENTLESSLY PRACTICAL (25)

"Do something that's big. Do something that really can change the world rather than something incremental" (26). – Robert Langer

At different times throughout his life, Robert Langer has been called "Father of Invention" (27), "The Edison of Medicine" (26), "The Problem Solver" (25), and the most cited engineer in history (26) with 170,000 citations and the highest h-index score, 210, in history for an engineer at that time (26). Today, his Google Scholar calculated citations exceed 270,000, and his h-index equals 264 (as of 1/3/19). He holds more than 1,300 issued and pending patents, which are licensed to more than 350 companies, and he is the founder of more than 40 start-ups (28).

In 2015, he was selected as the sole recipient of the QEPrize, "for his revolutionary advances and leadership in engineering at the interface with chemistry and medicine" (6). The citation for his award recognized Langer as "the first person to engineer polymers to control the delivery of large molecular weight drugs for the treatment of diseases such as cancer and mental illness. Over two billion lives have been improved worldwide by the technologies that Dr. Langer's lab has created" (6).

Today, the number of lives impacted by Langer's work is unimaginably larger, and he continues to innovate in new directions. While myriad interviews and articles have been published about Langer's background, inspirational process, and future research directions—including an in-depth interview in a previous issue of *Technology and Innovation*—several themes are constant. He considers his role as a professor and teacher, and mentor to his students, his priority (29). Currently the David H. Koch Institute Professor at the Massachusetts Institute of Technology, Langer is highly involved in his lab's research activities and has a reputation for being "famously accessible" (25) to students and colleagues alike. He is driven to find solutions to challenging problems and effect the translation of those solutions to technologies and processes that can have direct health benefits for as many people as possible (29). He is also willing to cross traditional boundaries, collaborate with unexpected disciplines, and take his research in unprecedented directions (26).

He has personally been described as "both visionary and relentlessly practical" (25), while his lab has been described as one of "the world's most productive and profitable research facilities" (26). The QEPrize summarized it this way:

> His training as a chemical engineer and fundamental understanding of the sciences enabled him to make advances at the intersection of new materials synthesis and applied engineering. In a time when few, if any, engineers worked in experimental medical research, Langer's perspective on medicine was unique: he saw surgery problems but created chemical and engineering

> solutions. Medicine at the time relied on existing, analogous materials. …Langer turned this approach on its head. Instead of using what seemed convenient, he asked the engineering design question: what do you really want, from an engineering, chemistry, and biology standpoint? His answer was to synthesize exactly what was needed to solve problems. Not only did he solve the problem of large molecule drug delivery, he fundamentally changed the way that we use materials in medicine. …Robert Langer translated engineering principles into human beings. (30)

Langer is recognized by most of the world's top awards for science, technology, engineering, medicine, and academic innovation, and he is one of only "four living individuals to have received both the United States National Medal of Science (2006) and the United States National Medal of Technology and Innovation (2011)" (28). His more than 220 awards also include the Charles Stark Draper Prize (2002), the Millennium Prize (2008)—considered the world's largest technology prize, the Priestley Medal (2012)—the highest award of the American Chemical Society, the Wolf Prize in Chemistry (2013), the Breakthrough Prize in Life Sciences (2014), and the Kyoto Prize (2014) (28).

Langer himself has said, "I'm thrilled that what I've done as a scientist and an educator has hopefully helped people. That was my dream, so I feel very happy about that" (29).

ERIC FOSSUM: PHOTO FINISH

"This prize really honors a string of inventors and engineers, and we stand on the shoulders of the giants who came before us" (31). – Eric Fossum

When Eric Fossum developed the "camera on a chip" in the early 1990s, he never imagined the immense impact it would have (32). His CMOS technology, which "captures light that comes from many sources and converts it into electrical signals" (32) made it possible to radically miniaturize cameras (32). In 2017, when Fossum received his award, more than 150 cameras a second were being made (33). In 2018, more than 5 billion image sensors were shipped to be installed in digital cameras, reaching an 8-year record high of nearly $14 billion in sales (34,35), and enabling a "photography boom" of an estimated 1.2 trillion digital photos taken worldwide in 2017 alone (36).

The 2017 QEPrize announcement recognized Fossum for this invention, and three others who "revolutionized the way we capture and analyze visualize information, [and] dramatically changed the way we communicate, enabling us to share information instantaneously, and communicate around the world in real time" (37): Dr. George Smith for the original concept of the charge-coupling principle as a form of computer memory; Dr. Michael Tompsett for developing the first imaging circuits using a charge-coupled device (CCD); and Dr. Nobukazu Teranishi for his development of the pinned photodiode (PPD) (38).

"Together, this image sensor technology has transformed medical treatments, science, personal communication and entertainment—from Skyping, selfies, computer games and feature length digital movies—to reporting live from wars using the small camera on a smartphone. It saves lives, by using non-surgical pill cameras and endoscopes inside our bodies to diagnose medical problems, as well as helping to reduce X-ray doses to patients and improving dental care" (4) the announcement stated.

However, Fossum explained "we really didn't foresee the social impact that ubiquitous camera technology would have on society, from Facebook and sharing pictures to be[ing] able to capture pictures of things live, and almost instantaneous transmission of that event to neighboring countries" (32).

The discovery did not come easily or simply. Fossum described it as a lengthy trial and error process, stretching into decades (39).

"A number of years ago, I worked at the NASA [National Aeronautics and Space Administration] Jet Propulsion Laboratory," he explained, "and I was asked to miniaturize the cameras that go on interplanetary spacecraft (40). They were already pretty large and I wanted to make them smaller. And I wound up inventing a technology called the CMOS image sensing technology or 'camera on a chip,' which allowed us to build really tiny cameras" (40).

Fossum's work built on the discoveries of Smith and the late Willard Boyle, who invented the CCD in the early 1970s, which converts photons into electrical signals (41). Thompsett's invention of the imaging semiconductor circuit followed, converting analog to digital data (41). Then, Teranishi's invention of the PPD enabled reductions in pixel size along with highly improved image quality (41). Finally, Fossum's CMOS technology "allowed cameras to be made smaller, cheaper and with better battery life, as each pixel has its own transistor that transmits information from each cell to the processor" (33). Fossum detailed the full story of his discovery and invention in a 2013 article in *Technology and Innovation*: "Camera-on-a-Chip: Technology Transfer from Saturn to Your Cell Phone" (42).

Early on, Fossum recognized the commercial potential of his invention. "This technology not only had really great application for space, but it also turned out to look like it had a lot of applications here on Earth," Fossum said. "So we wound up creating a spinout company from JPL (NASA's Jet Propulsion Laboratory) to develop and commercialize that technology" (40).

However, aside from NASA's utilization of this new technology, Fossum's invention was not immediately adopted for commercialization by existing companies (42). So, in 1995, Fossum, his colleague Sabrina Kemeny, and several others co-founded Photobit Corporation, which became not only the "first company to commercialize the CMOS image sensors" but eventually "the world's leading supplier of CMOS image sensors" (43,44). By 2000, the company had evolved its own spinout, Photobit Technology Corporation, for the consumer electronic sensor product market (42). Fossum served as CEO and chairman of the board for the new company as well as continuing to serve as chairman of the board for the original company (42). He also continued his entrepreneurial efforts and has since co-founded Gigajot (a Dartmouth spinout) and Active Pixel Associates, LLC (45).

Fossum has been recognized with dozens of national and international honors for his work. He is an inductee in the National Inventors Hall of Fame and Space Technology Hall of Fame; member of the National Academy of Engineering; Fellow of IEEE and Optical Society of America; has received the IEEE Andrew S. Grove Award, Society of Motion Picture and Television Engineers Camera Origination and Imaging Medal, Photographic Society of America Progress Medal, NASA Exceptional Achievement Medal, NASA Group Achievement Award, Yale University Wilbur Lucius Cross Medal for Distinguished Achievement, Yale Science and Engineering Association Award for Advancement of Basic and Applied Science; and was named an AAAS-Lemelson Invention Ambassador, among many other awards (45).

He is also the inventor on more than 160 issued U.S. Patents and 50 foreign patents (45), and his early photobit camera prototype and sensor has been on display at the Smithsonian Museum of American History (46).

He has retired twice, but in 2010 returned to academe as an active teaching professor and role model for the message he endeavors to inculcate in his students, especially the students in Dartmouth's innovative engineering Ph.D. program (45). As Fossum said,

> The purpose of Dartmouth's Ph.D. innovation program is not only to train world class engineering Ph.D.s, but also to give those Ph.D.s the skills and training necessary for them to create a viable enterprise if they happen to be so lucky as to have an opportunity knock on their door (40). We don't expect every one of our Dartmouth graduates to go out and immediately start a business upon graduation, but we want [them] to be prepared, so that if opportunity does cross [their] path, [they're] ready. (40)

So, what's next for Fossum? Like Cerf and Langer, he is already moving forward to the next innovation. At Dartmouth, he's working with his students on the next generation image capture device—a quanta image sensor, which counts individual photons (47). His start-up company, Gigajot, is based on this technology (47). While the potential applications are still being explored, Fossum encourages his students to try new things.

Fossum said, "In engineering and invention, you don't often get the right answer at the right time. It

took us several years to get CMOS right, and that was just in the research lab. It took even longer to get it right in a commercial and manufacturing sense. You have to repeat and try again. It's really important for students and teachers to learn and understand that lesson" (33).

He sums up the experience of inventing life-changing technologies in philosophical terms: "Technology transfer is as much about people as it is about technology. …It was truly a combination of the right technology, the right timing, a degree of luck, and determined persistence that made them work" (42).

ENGINEERING THE NEXT GENERATION

When the call for nominations for the 2017 QEPrize coincided with the 90th birthday of Her Majesty Queen Elizabeth II, the occasion inspired 18 world leaders in engineering and science to co-author a letter to *The Times* (London) about the impact of the QEPrize in the context of the past 90 years of engineering progress (48). An excerpt is included below:

> The winner will be a driver of change, an engineer who has engaged human imagination with the gears of technology.
>
> The Queen has lived through an era of profound change. One of the central themes of the past nine decades has been the impact of increasingly advanced technology on human life. The year 1926 marked Robert H. Goddard's invention of the liquid-fuel rocket and saw John Logie Baird demonstrate the first 'mechanical television.' Since then, the rocket has given us satellite communications, GPS, an eye on the universe, and discoveries about weather and physics that have revolutionised our view of ourselves and our planet; television has connected us globally, opening the way to an almost limitless source of information, education and entertainment.
>
> These were pioneering engineers, like those celebrated by the QE Prize, harnessing physical properties and chemical processes to the service of our species. Engineering does that for us. It is the servant of progress, indispensable to our future. We appeal to those who control government budgets for education, research and development to protect funding for the next generation of engineers, even in these straitened times. Their work will sharpen our vision of the future and drive greater productivity for the next 90 years. (48)

The authors of this letter included Lord Browne of Madingley, chairman, Queen Elizabeth Prize for Engineering Foundation; Professor Dame Ann Dowling, president, Royal Academy of Engineering; Dr. Brian Cox, professor of particle physics, University of Manchester; Professor Reinhard Hüttl, president, Acatech; Professor Hiroshi Komiyama, president, Engineering Academy of Japan; Dr. Dan Mote, president, U.S. National Academy of Engineering; and Dr. Narayana Murthy, founder, Infosys Plus, among others (48).

To help fulfill its role as a driver of change, the QEPrize vigorously engages young people through several initiatives, including an annual competition to design the trophy, which is unique for each year's awards (49). Competitors submit their designs through a specially-designed phone app (49). Thousands of entries are submitted each year, and the winning design is 3D printed (49). The winner also attends the award presentation at Buckingham Palace (49).

Young engineers are also involved through the QEPrize Ambassadors Network (50). Comprising graduate students or early-career engineers from around the world, QEPrize ambassadors are actively involved in communicating the importance of engineering and serving as role models for career opportunities in the engineering profession through networking, giving presentations to schools, attending international conferences, and participating in QEPrize events (50). Some of the recent ambassadors included Yasmin Ali, a chemical engineer and winner of the 2013 Women's Engineering Society's Young Woman Engineer award; Paolo Gomes, a specialist in fluid dynamics working for BP's Upstream Technology Wells team; Najwa Jawahar, a senior structural engineer at WSP Parsons Brinkerhoff; Brian Turyabagye, a telecommunications engineer and founding member of the team developing a pneumonia-detecting jacket for babies; Joanne Beale, a water and sanitation engineer; and John Collins, a

civil engineer with Arup who specializes in the structural safety of bridges (50).

The QEPrize additionally produces an Engineering Leadership Series—a collection of video interviews with corporate leaders of some of the top engineering firms in the world—and recently published *Create the Future* and *Create the Future: 16-17 Year Olds*, reports which provide perspectives on perceptions about engineering around the world, especially among young people (51).

CONCLUSION

Today, just a few years following its bold foundation, the Queen Elizabeth Prize for Engineering is regarded as "the highest accolade for engineers, recognizing the most significant contributions around the globe and empowering a new generation of engineers," said Professor Sir Christopher Snowden, Chair of Judges for the Queen Elizabeth Prize for Engineering. "By their very nature, QEPrize winning innovations are inspirational; they are relevant and understandable to everybody, and they have all had a remarkable social impact worldwide."

All three of the NAI Fellows recognized by the QEPrize continue to build upon their initial innovations and expand the impact of their inventions. They have demonstrated exceptional commitment to translating their innovations from academic research into opportunities to positively improve society. They also have focused their energies on encouraging their students and colleagues to do the same. In this way, they are helping to lead the future of the culture of innovation at universities.

In considering their accomplishments and impact, it is extremely gratifying to see the achievements of these three NAI Fellows honored by the Queen Elizabeth Prize for Engineering. Inasmuch as these three NAI Fellows have already changed the world with their inventions, they will have an equal impact on transforming our society to better understand and value innovation.

The world needs invention, it needs innovation, and it needs people willing to work tirelessly to create a better life for others. Recognizing and honoring academic innovation, the mission of the NAI, and the work of NAI Fellows are at the forefront of an innovation and entrepreneurial movement that is now sweeping across the world's universities (52). The NAI has been a proud partner in this movement, from championing the recognition of invention, patents, and commercialization activities for academic promotion and tenure to promoting the value of technology transfer to research universities beyond the purely financial value (53).

The legacy of the QEPrize will not only bring recognition to engineering inventors but also to the power of innovation itself. As Murthy explained, "Innovation undoubtedly creates opportunities across all branches of engineering. By developing strong skills in design and innovation, engineers can have an even greater impact on the world of tomorrow than they have had on the one of today. The Queen Elizabeth Prize for Engineering celebrates this spirit of innovation and encourages the engineers of tomorrow to follow in the footsteps of its auspicious winners."

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