

A BRIEF HISTORY OF THE IEEE ELECTRON DEVICES SOCIETY: PART I

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As we celebrate the 75th anniversary of the invention of the *Transistor*, we reflect the history of the *Electron Devices Society* (EDS) of the *Institute of Electrical and Electronics Engineers* (IEEE) over the last seven decades.

Since the invention of the *Transistor* [1]–[4], solid-state electronics has made a profound impact on humanity. This unprecedented progress in solid-state device technology over the past seven decades is the result of pioneering contributions and dedicated efforts of the people of the electrical and electronics engineering, specifically electron devices community. The EDS [5] is such a community of the professional association, the IEEE [6]. Currently, in the hierarchy of IEEE, the EDS is one of the 39 technical societies and seven technical councils under the IEEE Technical Activities Board (TAB) [7]. The growth of EDS over the last seven decades is inherently related to the evolution of transistor and transistor manufacturing technology for very large scale integrated (VLSI) circuits and systems enabling the digital ecosystem. Thus, *the history of the IEEE EDS is the story of the global engineering and academic community dedicated to advancing electron and ion devices related to technology for the benefit of humanity*. In this article, we reflect the origins of EDS and its growth becoming a true volunteer-led volunteer-driven global professional organization along with its diverse portfolio of publications as well as meetings and conferences on topics of interest to its technical community. Furthermore, the article also describes the strategic initiatives including educational programs and recognition of its members and luminaries of the electron devices community.

I. Origins of EDS

The origins of the IEEE EDS lie in the year 1952 as a committee of the then professional association, the *Institute of Radio Engineers* (IRE), established in the year 1912 [8]–[11]. However, the *Electron Devices Society* can trace its origins back to the 1930s, when the IRE *Technical Committee on Electronics* used to coordinate Institute's technical activities in the field of electronics; e.g., first three conferences on *Electron Tubes* starting in 1938 were held under auspices of the *IRE Committee on Electronics* [8]–[11]. In the meanwhile, with the increasing demands for electrical engineering professionals and the solid-state electronics in the 1940s, there had been a huge growth of IRE membership [8]–[11]. In order to address this growth, the IRE committee on electronics coordinating activities on *Electron Tubes* was extended in 1949 to

include *Solid-State Electron Devices*, and renamed the entity to *IRE Committee on Electron Tubes and Solid-State Devices*, often referred to as the “Committee 7” [5], [11]. The committee's first Chairman was Leon S. Nergaard of *Radio Corporation of America* (RCA), who served in that position until 1951 [8]–[11].

Note that the IRE “Committee 7” formed the IRE Professional Group on Electron Devices which would become the IEEE Electron Devices Society in ensuing decades through merger, subsuming different technical functionalities, and name changes (Figure 1) as described below.

IRE Professional Group on Electron Devices: After the invention of the *Transistor* at Bell Telephone Laboratories by John Bardeen and Walter Brattain in December 1947 [1], [2] and William Shockley in January 1948 [3], [4], the solid-state electron devices were beginning to attract major attention. Thus, in order to interact more directly with the rapidly changing electron devices technical community, the IRE “Committee 7” proposed to form a new group under the IRE's Professional Group system in the year 1951 [8]–[11]. By the end of 1951, the proposal was approved by the *IRE Executive Committee* (ExCom). And, on March 5, 1952, the *IRE Professional Group on Electron Devices* (PGED) was established. The *Administrative Committee* (AdCom) of the PGED held its first meeting on March 5, 1952 at IRE headquarters in New York City [11]. The first AdCom volunteers included George D. O'Neill of *Sylvania* as the first Chairman, Leon Nergaard as the founding Vice Chairman, and John Saby of *General Electric* (GE) as the first Secretary [11]. During its formative years, the new IRE PGED was led by highly experienced volunteer leaders. *Thus, on March 5, 1952, the antecedent of the IEEE Electron Devices Society was launched.*

The IRE PGED became the IEEE Professional Technical Group on Electron Devices after the amalgamation of the IRE and American Institute of Electrical Engineers (AIEE) in 1963 to become the IEEE [8], [12].

IEEE Professional Technical Group on Electron Devices: In 1940s, the dynamic growth of radio technology and the emergence of the new discipline of electronics led to stiff competition between the IRE and AIEE [8]–[12], though the AIEE had been the standards of excellence for electrical engineering (EE) professionals longer than the then rival association IRE. The AIEE was founded in 1884 by some of the most prominent inventors and innovators in the then new field of EE including *Nikola Tesla*, *Thomas Alva*

Edison, Elihu Thomson, Edwin J. Houston, and Edward Weston [9]–[12]. In the early 1960s, the IRE and AIEE recognized that their constituencies had been increasingly overlapped with needless duplication of staff, publications, and activities [8]–[12]. Thus, on January 1, 1963, the two institutes formally became one, *the Institute of Electrical and Electronic Engineers* or simply referred to by the letters “I.E.E.E. (pronounced I-triple-E),” in the year after the IRE celebrated its 50th (and the last) anniversary [9]–[13]. Both of these sweeping changes have fundamentally altered the practice of EE in the *United States of America* and throughout the world. On the very same day (January 1, 1963), the IRE PGED became the *IEEE Professional Technical Group on Electron Devices* (PTGED) [5], [11].

After the formation of the IEEE, the duplicate functionalities and committees of the IRE and AIEE related to electron devices were consolidated to form the *IEEE Electron Devices Group*.

IEEE Electron Devices Group: The IEEE PTGED merged with the *Solid-State Devices Committee* on July 1, 1963 and subsumed the functionalities of the AIEE’s technical committees on *Electron Devices* and *New Energy Sources* on May 20, 1964, and was renamed the *IEEE Electron Devices Group* (EDG). On June 23, 1965, the original *IRE Tubes Standards Committee* and *Solid-State Standards Committee* also fell under the new *IEEE Electron Devices Group* [5], [11] which after a decade, became today’s *IEEE Electron Devices Society* [5].

IEEE Electron Devices Society: In 1975, the IEEE EDG Ad-Com petitioned the IEEE TAB to ordain it as a *full-fledged Society* describing its maturity and increasing stability as an entity of the IEEE [11]. Under the Institute’s general practices, such a designation indicates that a Group’s financial resources are deemed strong enough to survive on its own as a completely independent organization. The petition cited the group’s *field-of-interest* (FoI) as “*electron and*

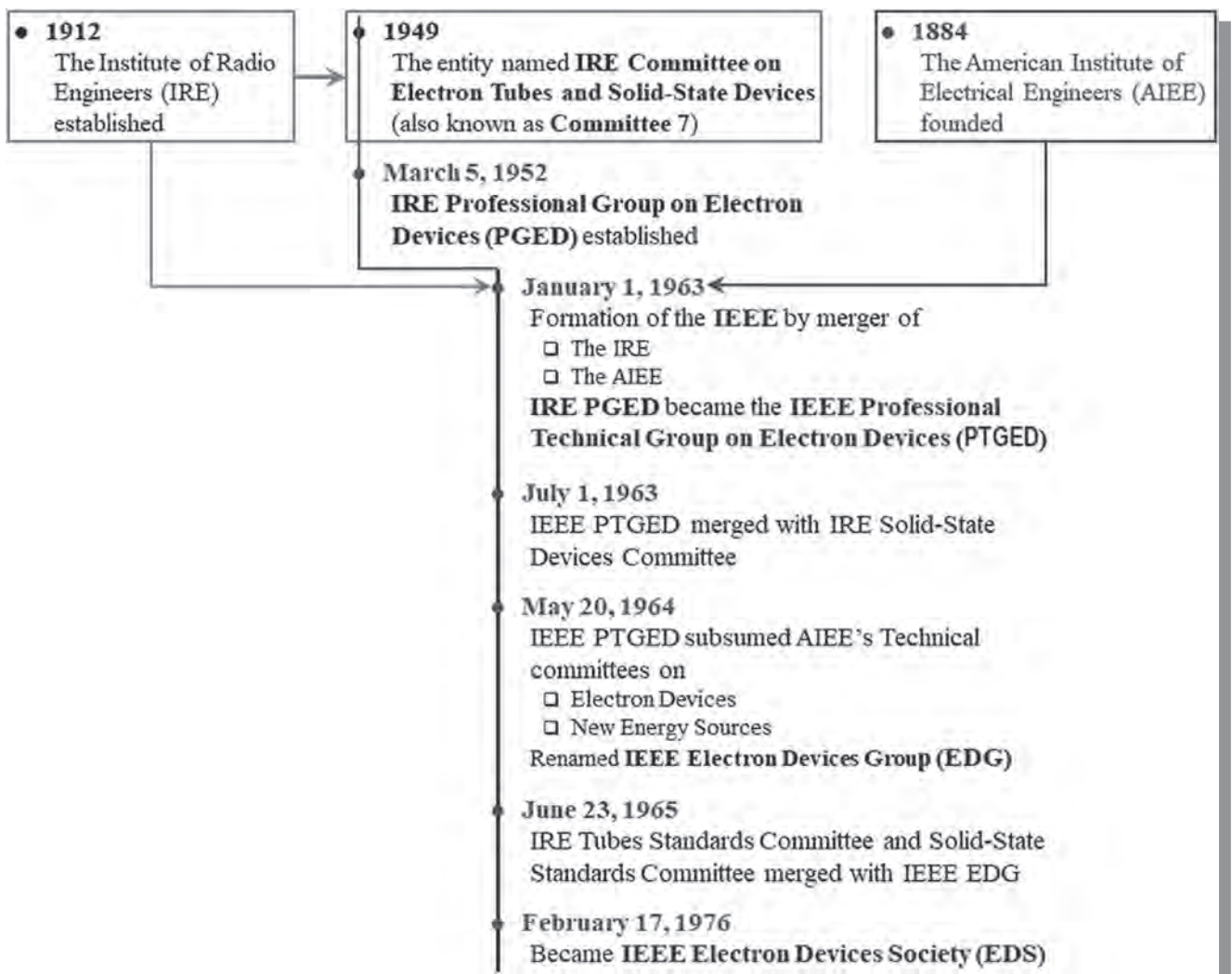


Figure 1. Origins of the IEEE EDS lie on March 5, 1952 as the IRE PGED. And, through mergers, subsuming different functionalities, and name changes in ensuing decades IRE PGED became the IEEE EDS on February 17, 1976.

ion devices including electron tubes, solid-state and quantum devices, energy sources, and other devices which are related to technology." The request was quickly granted. And, on February 17, 1976, the EDG formally became the *IEEE Electron Devices Society*, commonly referred to as the *EDS* [5], [11].

As shown in Figure 1, on March 5, 1952 the IRE PGED was established to interact directly to *electron devices community* and therefore, the origins of the IEEE EDS lie on March 5, 1952 as the *IRE Professional Group on Electron Devices*; which on January 1, 1963 became the *IEEE Professional Technical Group on Electron Devices*; on May 20, 1964 was renamed the *IEEE Electron Devices Group*; and on February 17, 1976 became the *IEEE Electron Devices Society*, EDS.

Throughout the twentieth century (second millennium) to date in the third millennium, the Society has grown to be one of the world's largest associations of electron devices professionals with about 10,000 members in over 160 countries worldwide.

II. Growth of EDS

After the establishment of the *IEEE Professional Technical Group on Electron Devices*, PTGED on January 1, 1963, the Group's major efforts had been consolidation of its technical activities, membership drive, and formation of chapters in the *United States (US) of America and beyond its borders* as well as globalization, sponsor meetings and conferences, launch new journals and a newsletter, and so on as described below.

Consolidation of Technical Activities: The responsibility for consolidating all professional activities of the merged IRE and AIEE groups under the new IEEE PTGED was primarily on Ray Sears of Bell Com, AdCom Chairman from July 1963 to June 1964 and Earl Thomas, Chairman from July 1964 to June 1966 [11]. Thomas set-up the new merged organization and its procedures to ensure that the major technical activities previously carried on by the groups and committees being merged are not lost. By the time Thomas stepped down in June 1966, the IEEE EDG activities had been reorganized into five associated sub-fields: (1) *Electron Tubes*; (2) *Solid-State Devices*; (3) *Energy Source Devices*; (4) *Integrated Electronics*; and (5) *Quantum Electronics* each under its own technical committee (TC) [11]. Note that the EDS TCs have grown in ensuing decades to diversify its technical activities within the emerging EDS Fol counting 16 at the end of the year 2022 [5].

Membership Drive: The membership drive started as early as in the 1950s by the IRE PGED. Through Group's concentrated efforts to form local chapters around the US, there were active chapters in Boston, Los Angeles, New York City, Philadelphia, San Francisco, and Washington, D.C. as well as lightly active groups in other areas of the country [11]. By December 1953, paid membership in the

full IRE PGED exceeded 1,000 engineers and scientists [11]. The Group continued its steady growth, and by December 1959, its membership exceeded 5,000 including students [11]. In the early 1970s, the total (IEEE EDG) membership grown over 9,300 including 32 percent student members and another 16 percent from overseas [11]. Consequently, the EDG was among the largest of the IEEE's professional groups. And, the growth and alignment of the Group continued under the IEEE.

Along with the growth of technical activities within the US, the Group concentrated its efforts to expand its presence beyond the US borders.

Electron Devices Group Beyond US Borders: During the 1970s, the IEEE EDG expanded its activities beyond US borders. These expansion efforts had actually begun back in the mid-1960s, when the IRE PGED's annual *Fall Washington D.C. Meeting* was renamed the *International Electron Devices Meeting (IEDM)* in 1965 [14]. During the late 1960s, non-US membership grown from less than 1,000 to just over 1,500, representing about 16 % of the total membership [11]. The largest foreign contingents were in Canada, Europe, and Japan; the Tokyo Section alone recorded nearly 300 members in 1969. European members took increasing part in the activities of the IEEE EDG, occasionally, cosponsoring meetings such as the *European Microwave Conference* and the *Symposium on Solid-State Device Technology*. There were also frequent exchanges of information with the *Japan Society of Applied Physics*. And in 1972, the annual *Device Research Conference* was held for the first time beyond the US borders at the University of Alberta in Edmonton, Canada [11].

In the mid-1970s, the IEEE EDG experienced membership decline and IEEE EDS membership dropped below 7,000 in 1978 [11]. This decline was partly due to the loss of members by reorganization of the EDS's *Quantum Electronics Council* as a separate *IEEE Group on Quantum Electronics and Applications* in 1977. However, renewed effort to membership drive brought the total number back above 8,000 by the end of the 1970s including over 25 % beyond US borders [11]. At the end of 1970s, the Society became financially healthy posting over \$300,000 cash reserves in the bank along with membership growth [11].

In the continued efforts to grow EDS beyond US borders, AdCom began to include Japanese representatives on its roster of elected members during the 1980s. In 1984, for the first time Asian member Takuo Sugano was elected to serve at AdCom followed by Yoshiyuki Takeishi in 1987 [11]. Previously, there had been two European members, Adolf Goetzberger and Cyril Hilsun on the committee. Thus, electing Japanese members, the IEEE EDS AdCom became a truly worldwide committee. Besides, the Society's policy to reimburse travel expenses of AdCom members, non-US members have been a regular

and continuing feature of today's EDS AdCom (renamed BoG in 2013) [5], [11].

AdCom's efforts for growth and diversification of Society's activities continued to establish EDS as a true global organization.

Managing Growth and Diversification: In the late 1980s, the growth and diversification of EDS technical activities within the US and overseas continued. During the year 1987, the EDS membership grew over 10,000 and had an annual budget exceeding a million US dollars [5], [11]. It published *two* professional journals of its own and co-sponsored *four* others. Furthermore, EDS sponsored almost 20 conferences a year and cosponsored with other societies nearly as many more. Thus, the Society's operations had become too complex and far-reaching for an all-volunteer organization. Therefore, during the year 1987, discussions began on the need to hire permanent professional staff to manage the day-to-day operations of the Society [5], [11]. However, such a major financial commitment was constrained mainly due to the expenses of new publications.

In the late 1980s, the EDS financial position improved under the new Treasurer (1988–1991), *Lu A. Kasprzak* of IBM, with annual surpluses often coming in well above \$100,000 and reserves exceeding \$1.5 million [5], [11]. The total paid membership, including students, was up to more than 11,000. Thus, with finances in much better condition, AdCom seriously considered the question of hiring professional staff. Therefore, the day before its June 1989 meeting, EDS President *Craig Casey* of Duke University, Meeting Committee chair *Michael S. Adler* of General Electric, Treasurer *Kasprzak*, and several past presidents met to discuss this issue. They concluded that such management was indeed required and that the Society's financial position is favorable. The needed office space was available at the new *IEEE Operations Center in Piscataway, New Jersey*. Subsequently, in October 1989, Adler, Casey, Kasprzak, *Friedolf M. Smits* (past Treasurer, 1980–1987), and the incoming EDS President *Lewis Terman* of IBM, decided to recommend the creation of the new, full-time position of *EDS Executive Officer* [5], [11]. And, in December 1990 meeting, AdCom unanimously endorsed their recommendation *to having Society's sprawling activities managed by an Executive Office with full-time staff of salaried personnel.*

EDS Executive Office Established: Upon approval to create a full-time position of *EDS Executive Office* by AdCom, the EDS leadership set out to hire an *Executive Director* [5], [11]. The search committee including Casey, Smits, and Terman interviewed candidates that summer and offered the position to *William (Bill) F. Van Der Vort*, the then Manager of the *Systems Department* at IEEE who had been working at IEEE since 1977. Accepting this offer, Bill started as the *EDS Executive Director* in August 1990 and retired in the year 2009. He led a growing team

at the Society's Executive Office in Piscataway, New Jersey to manage the Society's business and finances, coordinate its myriad meetings, and support the editing and publishing of its *Newsletter* and professional *Journals*. After Bill's retirement, Christopher Jannuzzi was hired as the EDS Executive Director in 2010 who served in full capacity through 2015 and parttime in the same position as the supervisor of the EDS Executive office Operations Director, James Skowrenski, during 2016–2019. Since 2020, the EDS Executive office is managed by Operations Manager, Ms. Laura Riello, who has been working at IEEE since 1987 [5].

Upon establishing the EDS Executive office in August 1990, the renewed efforts to globalization of EDS started with increasing technical activities within the EDS Fol.

Globalization of EDS: The efforts to globalization of EDS began during the 1980s adding AdCom members from Asia and Europe. In the 1990s, one of the major initiatives was to complete the globalization efforts to *convert the Society into a truly international organization* [5], [11]. In this endeavor, *Roger Van Overstraeten* of Belgium was elected to AdCom, its first European member in more than a decade [5], [11]. Shortly after, it became the standard EDS policy (*EDS Constitution & Bylaws*) to have *at least two elected AdCom members* from IEEE Region-8 (Africa, Europe, and Middle East) and another *two* from IEEE Region-10 (Asia and Pacific) [5]. By implementing this policy, AdCom's total membership grew from 18 to 22, the first of several increases in the 1990s and continues to-date in the early 2023. In order to make Society's growing activities more effective, an *EDS Executive Committee* (ExCom) was established consisting of the *Elected Officers, Junior and Senior Past Presidents, Chairs* (re-named as the *Vice-Presidents* (VPs) from the mid-2004) of key committees, and the *Executive Director* [5], [15].

During the 1990s, the Society's efforts to globalization had been a top priority. Under the leadership of EDS Presidents Terman (1990–1991) and Michael Adler (1992–1993), new chapters were established in Australia, Canada, China, Egypt, France, and Germany as well as in other countries [5], [11]. In order to sustain this rapid global expansion, the Society created a new *Regions/Chapters Committee* (SRC) appointing *Cary Yang* of Santa Clara University as the first Chairman. ExCom members occasionally visited these chapters and regions to help foster better communications and membership services [16]. And, the Society started the *Distinguished Lecturer* (DL) *Program* to present leading-edge and exciting technical research by quality lecturers to EDS chapters and members as well as facilitate communications among members, chapters, EDS, and IEEE [16]. In the ensuing decades, the DL program is extended to providing single or multiple DLs by a single or multiple lecturers in a Session and referred to as the "EDS Distinguished Lecturer/

Mini-Colloquia (DL-MQ) Program” [5]. By the time Adler stepped down in 1993, there were 59 EDS chapters in all, with 26 of them located beyond US borders; by the end of 1996, more than half of the chapters, 48 out of 85, were outside the US. The new EDS logo, *sporting a lone electron, represented by a spin vector, circling the globe*, was redesigned by Terman in 1992, reflects the Society’s broad international character [5], [11]. Thus, at the closing of 1990s, the IEEE EDS, as the true global association for the electron devices community, found itself in an enviable intellectual and financial position. The total number of 99 EDS chapters spread widely across the globe and the total membership exceeded 13,000 including more than 5,000 outside the US [5], [11].

In the third millennium, the Society’s global activities continue to grow. At the end of 2022, the EDS chapter grew to 240 including 88 joint chapters and 97 student branch chapters spread across the world with a total number of EDS membership of 10,769 [5]. Note that 37.7 % of total members are from IEEE Region-10 [5]. The declining EDS membership is partially due to the increasing number of students and young professionals seeking careers in the growing wireless networking communications technologies.

In the new millennium, the EDS leadership implemented new initiatives on educational as well as humanitarian activities to better serve the electron devices community.

Educational Initiatives of EDS: The Society continues to launch new strategic initiatives to enhance the value of EDS membership and chapters worldwide including student fellowship, encourage high school students to *Science, Technology, Engineering, and Mathematics* (STEM) education, and humanitarian activities. The EDS has been playing an active role in encouraging younger students to pursue careers in EE. In this effort, the EDS-ETC (*Engineers Demonstrating Science—Engineer Teacher Connection*) program was developed by Mid-Hudson region EDS chapter, New York, USA in the year 2010 through the leadership of Fernando Guarin of IBM, East Fishkill, New York. The EDS-ETC program is a highly successful and sought out program by EDS chapters worldwide [5].

To continue educational initiatives, in the year 2011, the EDS (2010–2011) President Renuka P. Jindal of the University of Louisiana at Lafayette, Louisiana, launched the EDS *webinar series* to deliver live lectures by luminaries within the EDS Fol [5], [17]. The first webinar entitled, “The FinFET 3D Transistor and the Concept Behind It,” was offered by Chenming Hu of the University of California, Berkeley on July 27, 2011. The live webinar has been one of the valuable strategic initiatives of EDS. Furthermore, the online repository provides EDS members with on-demand access to streaming videos of the past events [5], [17].

With increasing efforts to globalization and diversification of Society’s activities, it became important to rename

the Society’s governing body to appropriately represent its true Mission.

AdCom Renamed as the BoG: At the June 2012 AdCom meeting in Leuven, Belgium, Renuka motioned to renaming AdCom as the *Board of Governors* to more accurately reflect the volunteer-led volunteer-driven spirit of the Society. The EDS AdCom unanimously voted in favor of the Motion [18]. Subsequently, the change was approved by IEEE TAB. Thus, *from 2013 January, the EDS AdCom became the EDS Board of Governors or BoG*. All roles and functions of the BoG remain the same as the AdCom. However, the “BoG” represents the true governing body of the Society to carry out its envisioned Mission [5].

In order to financially support the growing educational and humanitarian initiatives, the Society moved forward to establish an EDS Mission Fund.

EDS Mission Fund: In the year 2013, under the leadership of President Paul Yu of the University of California, San Diego, the EDS partnered with the IEEE Foundation to establish the *IEEE EDS Mission Fund* of the *IEEE Foundation* [5], [19]. The fund is aimed to greatly enhance the *humanitarian, educational, and research initiatives* within the EDS Fol by providing members and other constituents of the EDS community with the ability to contribute directly to our mission-driven imperatives, such as the *EDS-ETC and EDS Student Fellowship* programs.

EDS Center of Excellence: Another educational program to engage high school students including under-represented girl students in STEM education, an *EDS Center of Excellence* was established at the Heritage Institute of Technology, Kolkata, India in 2017 through the effort of (2016–2017) President Samar Saha of Prospicient Devices, Milpitas, California [20]. This is the first of its kind educational program in EDS and IEEE and is aimed to encourage high school and undergraduate boy and girl students in EE and specifically device engineering, and choose device engineering as their professional career.

With continued changes in the electron devices technical area, the EDS leadership created a dedicated Future Directions Committee to move forward EDS in the future.

Future Directions: Since the formative years, the Society continuously diversified its technical activities in emerging areas to strategically position the Society at par with the changing technical fields. However, with the rapidly changing device technology, it has become crucial to have a formal future directions strategy to move forward EDS in the future device technology areas. In this effort, Samar initiated the EDS first five-year strategic planning with his goal to *build EDS on the foundation of the past to meet the challenges of the future* [20]. In continuation, (2018–2019) President Fernando appointed an ad hoc committee with Samar as the Chairman to continue strategic planning. In order to concentrate efforts on EDS future directions, Meyya Meyyappan, President (2020) of *National Aeronautics and Space Administration* (NASA) created

a Standing *Strategic Directions Committee* in 2020 with Paul Berger of Ohio State University as the Vice President. In 2022, Paul was replaced by Douglas P. Verret as the Vice President of the Future Directions Committee [5].

EDS Podcast: Similar to EDS webinar, the Society under the leadership of Meyya, launched EDS Podcast Series in 2020 to host interviews with some of the most successful members of EDS sharing their lives and careers to inspire students and young professionals. The first podcast was aired on January 15, 2021 with Muhammad Mustafa Husain of the University of California, Berkeley (now Purdue University, West Lafayette, Indiana) as the host [5].

III. Conclusion

The *Electron Devices Society*, EDS is a volunteer-led volunteer-driven global association of electron devices community of the *Institute of Electrical and Electronics Engineers*. The Society has grown worldwide over the past seven decades and continues to promote excellence in the field of electron devices for the benefit of humanity. *The Society's growth has been culminated by a growing portfolio of top-tiered professional journals and conferences on emerging topical areas which will be presented in the July 2023 Issue of this EDS Newsletter.*

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