

# Indian Women in Engineering - Past, Present, and Future

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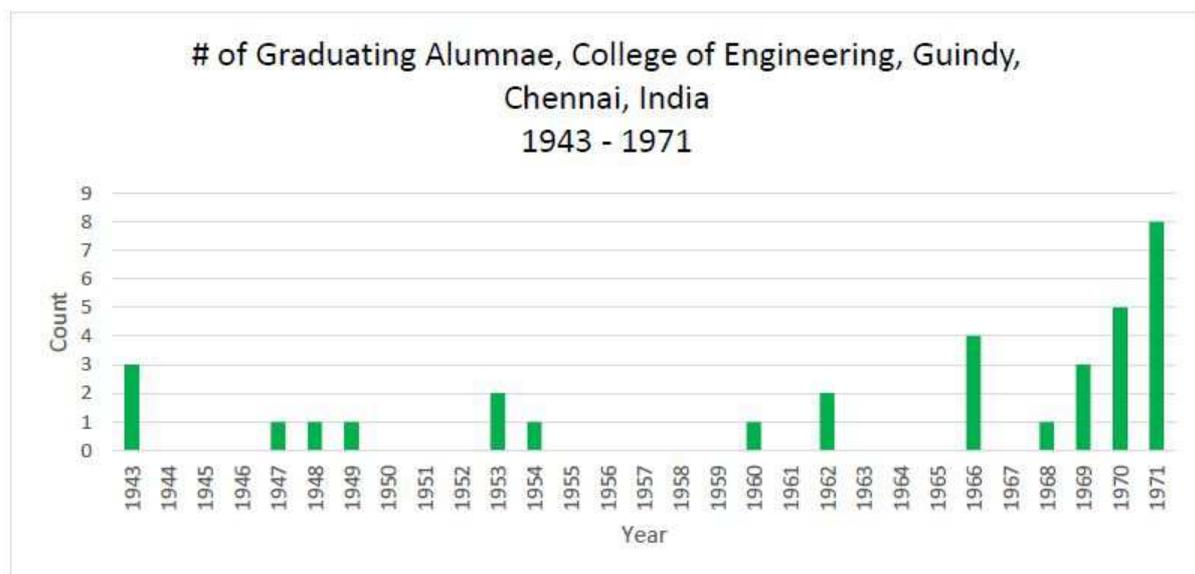
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In the early twentieth century, we considered engineering education a man's prerogative. Civil, electrical, and mechanical engineering were the main engineering disciplines. Today, engineering encompasses many more specializations such as computer engineering, software engineering, and computer science. Many women have successful careers in these disciplines, and the future looks bright for Indian women in engineering.

## The 1940s - 1980s

Medicine was a suitable field of education for women even as early as the late 1800s. Engineering was not. The first Indian woman to graduate with a medical degree was Anandibai Joshi in 1886. In India, the first set of engineering women graduated from the oldest engineering college in India, College of Engineering, Guindy (CEG), Chennai (1), in the 1940s. Around the same time, there was a woman who graduated from Pune Engineering College. But we know little about her. When writing the book "[Roots and Wings: Inspiring Stories of Indian Women in Engineering](#)", I found the statistics of how many women graduated each year from CEG fascinating.



This represents the conditions that existed in India in those decades. Many of the very early Indian women engineers pursued engineering because their fathers or families wanted them to do so. Their fathers or brothers were engineers. They encouraged the girl in the family, who was very good at mathematics and physical sciences, to pursue engineering. A. Lalitha, the first woman electrical engineer of India once said, 'Electrical engineering runs in my blood. My father, four brothers, nephew, and son-in-law are all electrical engineers.'



*The first set of women graduates of CEG: P.K. Thressia, Leelamma George, and A. Lalitha  
Image courtesy of Syamala Chenulu*

CEG produced some of India's first women engineers in their fields. Rajyalakshmi was the first woman to graduate with a telecommunications degree in 1948 and worked in All India Radio. The first woman to graduate with a mechanical engineering degree in 1966 was Sarojini, who went into her family business.

Because the women were rare in the field that was predominantly men, they felt accepted, though considered exceptions. Many of them were happy to consider advancing in their careers secondary to that of their husbands. Several of them worked in the Government of India establishments, which treated them fairly by transferring them to the same locations as their husbands to keep them together. Some of them received help from the extended family structure, with aunts and uncles lending helping hands.

A few of these early pioneers did not marry and devoted their entire lives to their careers or social services. One of the first set of women who graduated from CEG, P.K. Thressia became the first lady chief engineer in Kerala's Public Works Department (PWD).

Many early female engineers became technical educators. There were several CEG graduates who became principals of women's polytechnics and also principals of colleges.

At the tail end of the period in the book is one of the globally successful early engineers, Radha Ramaswami Basu. A distinguished alumnus of CEG, she graduated in 1971.



*Radha Ramaswami Basu*  
*Image courtesy of Radha Basu*

Radha migrated to the USA, pioneered the entry of Hewlett-Packard into India in the then-nascent IT industry, and became a serial entrepreneur. In 2006, Radha and her husband Dipak launched Anudip Foundation, a social enterprise in India, to address critical livelihood needs of youth and young women of rural and urban India through information technology. She is still going strong with her social enterprise iMerit Technology in West Bengal.



*Vinita Gupta*  
*Image courtesy of Knowledge@Wharton*

Vinita Gupta, a distinguished alumnus of the University of Roorkee, (now Indian Institute of Technology Roorkee) 1973, also migrated to the USA and founded Digital Link Corp. (later named Quick Eagle Networks) and took it public, the first Indian-born American woman to do so. She sits on the boards of Palo Alto Medical Foundation in California, the Indian School of Business, and the Cancer Prevention Institute of California.



*Jayathi Murthy*  
*Image Courtesy of UCLA*

Dr. Jayathi Murthy, a distinguished alumna from IIT Kanpur graduated in 1979 with a degree in mechanical engineering. Her Ph.D. is from the University of Minnesota. She became the dean of the UCLA Henry Samueli School of Engineering and Applied Science in 2016. Her academic career started at Arizona State University as an assistant professor of mechanical and aerospace engineering. Other universities that shaped her career include Carnegie Mellon, Purdue, and The University of Texas at Austin. She also had industry experience at Fluent, Inc. There, she led the development of algorithms and software.

## **The 1980s – Present**



*Padmasree Warrior*  
*Image Courtesy of LinkedIn*

Many Indian female engineers who graduated in the 1980s have become globally successful. Padmasree Warrior is one of them. She received a bachelor's degree in chemical engineering from the Indian Institute of Technology, Delhi, in 1982 and a master's degree in chemical engineering from Cornell University. She has won many awards for her leadership in the tech industry and has held many board positions. She is on the boards of Microsoft, Spotify and Thorn (formerly DNA Foundation).



*Kalpana Chawla*  
*Image Courtesy of Wikipedia*

Dr. Kalpana Chawla graduated in 1982 with a bachelor of science degree in aeronautical engineering from Punjab Engineering College, India. 1982. In 1988, she received a Ph.D. in aerospace engineering from The University of Colorado. In 1989, she started working at NASA Ames Research Center. In 1994, she became an astronaut candidate. Her first flight in space was in November 1997 on the space shuttle Columbia, where she was a mission specialist. Her second flight was in 2003, which failed on its way back to earth and claimed her life.



*T.V. Geetha*  
*Image Courtesy of Guindy Times(2)*

Dr. T.V. Geetha, who graduated from CEG in 1982 with a degree in Electronics, did a Ph.D. in Natural Language Processing from Anna University in 1992. She headed the computer science department between 2003-2006, and also in 2013. She became the first woman dean of CEG. In 2000, she received the Young Scientist award from the Government of Tamil Nadu. She is the author of many technical and research papers.



*Janaki Akella*  
*Image courtesy LinkedIn*

Dr. Janaki Akella, also a 1982 graduate, is a distinguished alumnus of CEG. In December 2018, the Board of Directors of Southern Company, a leading energy company, elected Dr. Janaki Akella as an independent director, joining the Operations, Environmental and Safety Committee and the Business Security Subcommittee. Akella has served as the Business Leader, Digital Transformations at Google since 2017. She has also held various positions with McKinsey & Company. She earned a doctorate from Carnegie Mellon University and a bachelor's degree from the College of Engineering in Guindy, India.



*Vanitha Muthayya*  
*Image Courtesy: India Today*

Vanitha Muthayya, a 1985 graduate of CEG headed India's second lunar mission. A celebrated electronics system engineer from the UR Rao Satellite Centre, she is the author of many papers on satellite communications. In 2006, she received the best woman scientist award from the Astronautical Society of India. The science journal *Nature* has named her as one of the five scientists to watch out for in 2019.



*Sarita Adve*  
*Image Courtesy: <https://anitab.org/profiles/abie-award-winners/sarita-adve/>*

Dr. Sarita Adve, who received a B.Tech. in Electrical Engineering from IIT-Bombay in 1987 and a Ph.D. in Computer Science from the University of Wisconsin-Madison in 1993 is a celebrated innovator and educator. She has received many awards. The *Anita Borg Institute Women of Vision award in innovation* is one of them. The Association for Computing Machinery (ACM) and IEEE Computer Society (IEEE-CS) awarded her the *2018 ACM/IEEE-CS Ken Kennedy Award (3)*“ for research contributions and leadership in the development of memory consistency models for C++ and Java, for service to numerous computer science organizations, and for exceptional mentoring.”



*Ponni K.*  
*Image Courtesy: IIM Bangalore*

Ponni K is Head, Global R&D Laboratories, Nokia, Bengaluru. She received the *Women Technologist of the Year 2019 award* from IEEE/Smart-Tech. She received her B.E. in computer science from Regional Engineering College, Trichy, (now National Institute of Technology) and an MBA from IIM-B.



*Bhargavi Sunkara*  
*Image Courtesy: LinkedIn*

Bhargavi Sunkara graduated from Jawaharlal Nehru Technological University in 1990 with a bachelor's degree in electrical and electronic engineering and a masters' degree in electrical engineering from Texas A&M University in 1994. She played various technology roles at Satyam Computers, MCI, Texas Instruments, Microsoft, and American Express, before becoming the Head of Corporate Technology at BNY Mellon, Pune.

The percentage of Indian women engineers rose dramatically, from almost 5% in 1980 to close to 30% in 2011.(4) We can attribute this growth in women to the growth in the computer industry and the introduction of degrees in computer engineering, software engineering, and computer science.

While the number of Indian women engineering graduates has grown substantially over the past decade, the percentage of women in the workforce has been declining on the whole (5), and those working in the technical fields follow a similar trend. Almost 40% of women engineering graduates are unemployed.(6)

The article "A Look at Gender Bias in India" (7) talks about a study which revealed both men and women feel bias at work in some form or the other, leading to attrition. India's Shops and Establishments Act (SEA) was one reason women felt discriminated against. The article concluded:

"When employees face bias in the workplace, they feel less engaged, are less satisfied with their jobs, and are more likely to consider leaving. We see these outcomes from both men and women engineers in India."

### **The Future**

It is a wonderful time for women to enter the workforce. The corporate environment has become more aware of the importance of cultivating women leaders. Corporate cultures are becoming more inclusive, more diverse. Today's women have grown up in a world that values gender equality much more than in the past. They are much more confident, independent, knowledgeable, and driven to succeed. There are amenities available to working women today – someone to do your shopping, services to deliver food, etc. – that make it possible for women to spend more time on their careers if they choose to. There is also more support for women, from women, understanding that together we go further.

Organizations such as SWE India (<https://india.swe.org/>), IEEE Women in Engineering (<http://wie.ieeeer10.org/>), and AnitaB.org India (<https://anitab.org/about-us/india/>) have all been very active in promoting the participation of women in engineering. SWE's *WE Local* initiative promotes meeting locally and learning socially. The *WE Local India*, which has plans to meet on April 2020 in Bengaluru (8) aims to support programs for women in all stages of their working life from graduation through retirement.

Women engineers who are graduating today will become tomorrow's engineering leaders. The advances in technologies such as the Internet of Things (IoT), autonomous vehicles, robotics, artificial intelligence and machine learning, space exploration, and genetic engineering are all fields that can benefit from the women engineers' mindset.

My goal in writing *Roots and Wings*: <https://notionpress.com/read/roots-and-wings> was to put engineering women role models in front of girls to highlight that women could do anything they choose to. I continue to showcase such women on social media such as *Roots and Wings*: <https://www.facebook.com/IndianWomenEngineers/> and *Women of College of Engineering, Guindy*: <https://www.facebook.com/cegwomen/>

The introductory chapter of *Roots and Wings* called out the need for participation by women in the workforce and the support they need from society:

"Critical events in women's lives such as marriage, babies, and elder care interrupt women's work life. Coming back to work from that interruption in these fast-changing days is hard. It is important that women refresh their skills and re-enter the world of work if they are to make progress. The life stories in this book show examples of women resourcefully navigating such interruptions to find their way back to successful careers. Women need support from their parents, their spouses, and the society, to achieve their dreams and goals—the support that men already get! The enterprises that employ them also have a role to play in supporting the career and meeting the special needs of their female workers. The institutions reap the benefits of women's contributions when they support them during the practically unavoidable breaks in their careers and their re-entry into the workforce after such breaks. The larger society also stands to enjoy the contributions facilitated by such support (9)"

In the 2011 Knowledge@Wharton interview, Vinita Gupta (10) says:

“Change has come, but it is not sufficient. We are somehow too slow to change our habits. I feel passionately about this. The way we raise our girls is different from the way we raise our boys. And it is different not because we want it to be different. It’s different because we are victims of our habits. Internally we know the boy has to launch himself in the world, he has to be able to make a living and so on. We have a different way in helping this boy grow up within the four walls of the home. But we don’t give a girl much freedom in thinking.”

This may still be true in 2019.

Here is what I tell my female engineer mentees who are just starting out in their careers:

“When it comes to your career, ignore gender. Be focused. Have great aspirations and work towards them. Put excellence and quality into everything you do. Stay current on technical advances. Build yourself a strong support network - starting with your spouse if you have one. Find a mentor, a sponsor, who can help you grow. Let your work speak for itself, but make sure you are visible in the organization and your chosen industry. Don’t be afraid to beat your drum. (11)”

Indian women are highly flexible, courageous, determined, ambitious, and have a high degree of emotional intelligence. In tomorrow’s globally connected world, they will go very far.

## REFERENCES

- (1) CEG, 223-year-old technical institution, gets first lady dean <https://www.deccanchronicle.com/nation/in-other-news/020617/tamil-nadu-ceg-223-year-old-technical-institution-gets-first-lady-dean.html> accessed on August 7, 2019
- (2) <https://guindytimes.com/articles/inspiring-and-motivating-ceg-an-interview-with-the-1st-woman-dean-of-ceg>
- (3) Professor Sarita Adve Recognized with 2018 ACM/IEEE Computer Society Ken Kennedy Award <https://www.computer.org/press-room/2018-news/2018-ken-kennedy-award-sarita-adve>
- (4) Women Engineers: A Comparative Study between India and Australia, Dr. Seema Singh, Er. Susan Lee Fenton, International Journal of Advancements in Research & Technology, Volume 3, Issue 7, July-2014 <http://www.ijoart.org/docs/Women-Engineers-A-Comparative-Study-between-India-and-Australia.pdf> accessed on August 7, 2019
- (5) World Bank Report, May 29, 2017 <https://www.worldbank.org/en/news/press-release/2017/05/29/india-economic-fundamentals-remain-strong-investment-pick-up-needed-sustained-growth-says-new-world-bank-report> accessed on August 7, 2019
- (6) Number of unemployed women engineers in India is as high as 40% <https://www.thehindu.com/news/national/tamil-nadu/Number-of-unemployed-women-engineers-in-India-is-as-high-as-40/article14590448.ece> accessed on August 7, 2019
- (7) A Look at Gender Bias in India <https://alltogether.swe.org/2019/04/a-look-at-gender-bias-in-india/> accessed on August 7, 2019
- (8) <https://welocal.swe.org/bengaluru/schedule/agenda/> accessed on August 7, 2019
- (9) The economic benefits of gender parity by Anu Madgavkar, Kweilin Ellingrud, and Mekala Krishnan, March 8, 2016, <https://www.mckinsey.com/mgi/overview/in-the-news/the-economic-benefits-of-gender-parity> accessed on August 7, 2019
- (10) Breaking the Gender Barrier: Vinita Gupta on Creating More Women Technology Entrepreneurs accessed August 2019 <https://knowledge.wharton.upenn.edu/article/breaking-the-gender-barrier-vinita-gupta-on-creating-more-women-technology-entrepreneurs/>
- (11) Dr. Shantha Mohan: Uplifting Engineers Through Storytelling <https://www.cmu.edu/iii/about/news/2019/roots-and-wings.html> accessed August 7, 2019

## About the author



Dr. Shantha Mohan is a senior software engineering leader and entrepreneur, with a proven track record of growing and mentoring technical teams and generating ROI for customers across the globe. Retail Solutions Inc., the company she co-founded, is a leader in retail analytics in the Consumer Packaged Goods (CPG) domain. She ran product development for the company and scaled the product development team across the world and delivered multiple analytic applications. Prior to Retail Solutions, she has over 20 years of experience focusing on mission-critical systems to support semiconductor and other high value-added manufacturing. At Consilium, now part of Applied Materials, she managed the development of three generations of manufacturing execution systems that are mission-critical, highly scalable, and highly available. Companies such as Intel, AMD, and Infineon depend upon them for their manufacturing.

In her current role as Executive In Residence at the Integrated Innovation Institute, Carnegie Mellon University (CMU), Shantha co-delivers courses, contributes to curriculum design, and mentors students in their projects and practicums.

Outside CMU, she guides students and startups and provides career advice in product management and software development careers. She is the author of *Roots and Wings: Inspiring Stories of Indian Women in Engineering*.

