Carnegie Mellon University
Electrical & Computer Engineering

FIRE
Foster • Impact • Research • Educate
Strategic Plan 2020
FROM THE DEPARTMENT HEAD

Dating back to the early 20th century, the Department of Electrical and Computer Engineering (ECE) at Carnegie Mellon University has had an illustrious history of excellence. We have long been recognized as a leader because of our research output, entrepreneurial spirit and innovative approaches to education. With just under 1,400 individuals, ECE is the largest department at Carnegie Mellon. Although the majority of our work takes place at our Pittsburgh and Silicon Valley campuses, our collaborations extend far and wide across the globe, including programs in China, Portugal, Rwanda and Singapore. Our students are rigorously trained in the fundamentals of engineering, with a strong slant towards the “maker culture” of learning by doing.

We have spent the past two years working together to assess our strengths and areas for improvement to create a blueprint for the next five years. The process has been thorough and inclusive; we have used a number of venues for ample discussion and to collect feedback. These venues included student, faculty and staff town hall meetings, informal faculty gatherings, retreats, Alumni Council meetings, surveys and many others. The result of this effort is this strategic plan; it will serve as a guiding light for the next few years. We call it FIRE (Foster, Impact, Research, Educate).

Fostering an inclusive, exciting and mindful environment is our goal. The best work happens when we play; through our environment, we must unlock and unleash that creative energy.

Impact is what drives us; we want to leave a footprint behind and help solve important societal problems.

Research is at the core of our enterprise; we will focus our attention on strategic thrust areas that solve important real-world challenges.

Educating creative, competent and mindful engineers who will become trailblazers is what we do best.

I am grateful to our students, faculty, staff and Alumni Council for their work on creating this plan, which will provide the roadmap for the next five years and will propel our department to the next level of excellence.

Jelena Kovačević
David Edward Schramm Professor and Department Head

Jelena Kovačević is the David Edward Schramm Professor and Head of the Department of Electrical and Computer Engineering and Professor of Biomedical Engineering at Carnegie Mellon University. She received a Ph.D. degree from Columbia University. She then joined Bell Labs, followed by Carnegie Mellon University in 2003. She received the Belgrade October Prize, the E.I. Jury Award at Columbia University and the Philip L. Dowd Fellowship at Carnegie Mellon University. She is a coauthor of the textbooks Wavelets and Subband Coding and Foundations of Signal Processing, as well as award-winning papers. Dr. Kovačević is the Fellow of the IEEE and was the Editor-in-Chief of the IEEE Transactions on Image Processing. She was a keynote speaker at a number of meetings and has been involved in organizing numerous conferences. Her research interests include applying data science to a number of domains such as biology, medicine and smart infrastructure; she is an authority on multiresolution techniques, such as wavelets and frames.
THE NEXT STEPS

FIRE: Foster, Impact, Research, Educate presents the strategic plan that sets the course for Carnegie Mellon University’s Department of Electrical and Computer Engineering for the next five years. The plan articulates our vision and mission and maps the path for its execution.

The ECE Department has been a leader in both research and education for years; it is known for its innovative qualities, boldness of ideas and unbridled enthusiasm. This plan follows in these footsteps by putting pen to paper to articulate the shared vision that will bring together all ECE people and resources. FIRE is a commitment guided by our core values to propel us even further on the road of scholarly excellence and societal impact.

Core values

We value scientific truth, creativity, quality, innovation and engineering solutions, all within a diverse and inclusive community guided by respect and the joy of doing.

• We respect each other; this is evident by what we do, by recognizing and celebrating everyone’s abilities and achievements, including respect as an end, not just as means to an end.

• We value a culture of inclusion and welcome diversity in people, cultures and opinions; true insight and novel solutions come from looking at challenges from different perspectives.

• We act with integrity; those around us can expect an open, reliable and trustworthy rapport.

• We aim to solve fundamental scientific and engineering problems that have significant societal impact; to do that, we employ our creativity to generate impactful solutions and rely on our entrepreneurial spirit for wide dissemination.

Our core values form the foundation for what we do. We believe in solving problems that have large societal impact. We also believe that success stems from an environment of enthusiasm and openness, respect and integrity and freedom to express and explore a variety of ideas.

Our vision is our guiding light. It informs and propels us in the right direction. The strategies of how to follow that path change over time; the vision does not.

Vision

To be a creative driving force, within the university and worldwide, of highest scholarly and entrepreneurial quality.
Our mission is our “what, who, how.” It explains what we do, who we do it for and how we do it so we engage the “hearts, heads and hands” of our students, faculty and staff in achieving our objectives. The strategic objectives coming out of this mission form our path forward.

**Mission**

To inspire, educate, and produce electrical and computer engineers capable of tackling fundamental scientific problems and important societal challenges, and to do so with the highest commitment to quality, integrity, and respect for others.

We aim to be the best at what we do and to apply our skills and knowledge to execute our vision. We educate students to become engineers who are sought after by industry, academia and government; we do so in an environment imbued by enthusiasm and love for what we do, with respect and willingness to listen to each other, with freedom to express our ideas and look at challenges from different points of view. We strive to be the ECE department of choice for those who are willing to step off the beaten path, for the visionaries and dreamers.

We are committed to propelling ourselves to the next level along all the axes of importance: research, education, the environment in which we work and societal impact. We will do so by bringing together our students, faculty and staff, industrial and governmental partners, as well as our alumni, in forging a strategic vision and environment that promotes success.

We will work towards our vision by focusing on creativity, innovation, entrepreneurship, scholarly work of the highest quality and the impact we have on society. We will achieve this vision through the following four strategic objectives:

**Strategic objectives**

- **F** Foster an exciting and inclusive environment that motivates our students, faculty and staff to achieve and create at the highest levels
- **I** Impact society through the scientific and entrepreneurial work we do and the people we educate
- **R** Lead the research & discovery of cutting-edge solutions to fundamental scientific and real-world engineering challenges
- **E** Provide high quality, innovative education to future intellectual leaders and technical trailblazers
Foster an exciting and inclusive environment that motivates our students, faculty and staff to achieve and create at the highest levels

The Department of ECE at Carnegie Mellon has long been recognized as a leader because of its research output, entrepreneurial spirit and innovative approaches to education. To sustain and improve our status and global impact, we must continue to attract and retain talented students, faculty and staff. An inclusive environment and diverse backgrounds are essential to fostering creativity and generating innovative solutions to challenging problems. Furthermore, striving for mindfulness in decision-making and self-reflection is integral to maintaining our leadership role in research and achieving high quality of life for our students, faculty and staff. The department is committed to providing both the resources for mentoring and career-long support for professional development and leadership training for students, faculty and staff.

STRATEGIES AND ACTIONS

F.1 Provide support and foster a high quality-of-life environment for our students
   F.1.1 Provide student support, especially at critical stages and for underrepresented groups
   F.1.2 Promote student contact with faculty in nonacademic settings
   F.1.3 Promote student participation in ECE organizations
   F.1.4 Provide space for community interaction
   F.1.5 Provide high-quality career services

F.2 Provide support and foster a high quality-of-life environment for our faculty
   F.2.1 Provide onboarding of new faculty
   F.2.2 Provide junior faculty training & mentoring from the moment an offer is accepted
   F.2.3 Provide faculty training on management, teaching, professional, administrative skills, etc.
   F.2.4 Help balance work and family time

F.3 Provide support and foster a high quality-of-life environment for our staff
   F.3.1 Develop, expand and strengthen the staff structure to support departmental strategy
   F.3.2 Ensure meaningful staff career paths, feedback and reward system
   F.3.3 Establish incentive programs to encourage staff to participate in meaningful processes
   F.3.4 Create an optional faculty advocate program for staff
   F.3.5 Mentor faculty on how to ensure we keep excellent staff

F.4 Engage our alumni as one of the cornerstones of our community
   F.4.1 Develop an alumni engagement strategy
   F.4.2 Engage alumni to mentor, develop and inspire students
   F.4.3 Reach the “lost” alumni from the 80s

F.5 Foster inclusion, mindfulness and introspection in day-to-day operations
   F.5.1 Train students, faculty and staff in identifying and mitigating unconscious bias
   F.5.2 Establish resources and/or spaces for informal social interaction or mindful self-reflection
   F.5.3 Train faculty to be mindful of the power that comes with the position

F.6 Foster a sense of community through communications, events and annual giving
   F.6.1 Establish channels for transparent communications
   F.6.2 Create joint events to promote a sense of community
   F.6.3 Develop a culture of participation in annual giving for students, faculty and staff

F.7 Develop metrics for success to drive and characterize progress
Impact society through the scientific and entrepreneurial work we do and the people we educate

The Department of ECE at Carnegie Mellon has had a long history of being at the forefront of technological innovation by successfully turning ideas into impactful societal and entrepreneurial endeavors. We aim to further enhance and promote the awareness of our achievements outside institutional confines, from popular and social media to the lay population. We will encourage and support impactful innovation from our faculty and students, deftly create and use marketing materials to make the department better known to the outside world and work with our global campuses as well as our alumni network to amplify this message.

STRATEGIES AND ACTIONS

I.1 Be recognized as innovative technical leaders
   I.1.1 Create a two-way Communications Office – faculty channel
   I.1.2 Increase recognition through educational contributions
   I.1.3 Increase recognition through research accomplishments
   I.1.4 Increase recognition through activities with industry
   I.1.5 Increase recognition through activities with the government

I.2 Promote innovation and entrepreneurship in education to produce future intellectual leaders and technical trailblazers
   I.2.1 Create innovation and entrepreneurship educational content

I.3 Promote innovation and entrepreneurship in research to transition our best work
   I.3.1 Establish an ECE-level entrepreneurship faculty committee
   I.3.2 Strengthen our relationships with industry

I.4 Leverage our global presence for worldwide impact
   I.4.1 Integrate all ECE locations to provide benefits to all
   I.4.2 Leverage our presence in Silicon Valley
   I.4.3 Leverage our presence in China, Portugal, Rwanda and Singapore

I.5 Develop metrics for success to drive and characterize progress
Lead the research & discovery of cutting-edge solutions to fundamental scientific and real-world engineering challenges

The Department of ECE at Carnegie Mellon has long been a leader in a number of focused research areas, all of which were born through core strengths as well as insightful leverage of our interdisciplinary might. Tied to the mission of educating holistically in a global context, the department will strive to solve open problems in technology, engineering and science for the betterment of society. Furthermore, engineering solutions to challenging problems must incorporate thoughtful foresight, not only in their immediate technological impact but also in their long-term societal implications. To achieve these goals, we will continually evaluate areas of strategic interest, work on attracting and retaining the highest quality students, faculty and staff, encourage and promote fundamental work as a bedrock upon which our disciplines are based, establish an efficient research infrastructure and strengthen our industrial and governmental relationships.

STRATEGIES AND ACTIONS

R.1 Be technological trailblazers
   R.1.1 Perform an annual SWOT analysis to understand major trends in critical future technical areas as well as current strengths and weaknesses in terms of our research
   R.1.2 Annually update ECE strategic thrusts to drive hiring and investment

R.2 Attract a diverse faculty body of the highest quality
   R.2.1 Establish clear, transparent and inclusive faculty search/hiring procedures
   R.2.2 Build a pool of top faculty candidates from underrepresented groups
   R.2.3 Identify top faculty in the department’s strategic areas
   R.2.4 Find faculty lead(s) to manage headhunting

R.3 Attract a diverse student body of the highest quality
   R.3.1 Establish clear, transparent and inclusive student recruitment procedures
   R.3.2 Create a pool of high-quality students
   R.3.3 Develop effective and innovative methods for student selection
   R.3.4 Vigorously and proactively recruit admitted students

R.4 Promote fundamental work as a bedrock upon which our disciplines are based
   R.4.1 Establish seed funding for underfunded fundamental work
   R.4.2 Promote fundamental work through seminars, increase nominations for awards and visibility

R.5 Leverage our interdisciplinary strengths to lead large research initiatives
   R.5.1 Invest/organize informal gatherings as well as focused research retreats and workshops to form/maintain/grow research initiatives within the department and across the university
   R.5.2 Promote research awareness among faculty in different areas via joint seminars, presentations, videos and informal lunches
   R.5.3 Establish seed funding for strategic directions

R.6 Provide a world-class infrastructure to support our research enterprise
   R.6.1 Attract a world-class, competent and diverse staff body
   R.6.2 Reduce administrative load; lower barriers to legal and contract issues
R.6.3 Invest in staff and resources to enable our research initiatives
R.6.4 Develop standard and streamlined practices to enable our research initiatives
R.6.5 Establish a clear path for financial health through effective budget review and planning
R.6.6 Strategically focus on alumni and major-gift donors to create opportunities for endowed chairs, research, infrastructure support, etc.
R.6.7 Create a directory of infrastructure for promoting community usage and maintenance
R.6.8 Establish our space goals for the future and develop a plan to attain them
R.6.9 Periodically review and establish goals for information technology operations and services

R.7 Strengthen industrial and government relationships
R.7.1 Have corporate relations facilitate connections with high-up contacts within companies
R.7.2 Build master intellectual property agreements
R.7.3 Leverage direct gift alumni database for research funding
R.7.4 Engage alumni to strengthen connections with industry, government and academia

R.8 Develop metrics for success to drive and characterize progress
R.8.1 Track awards compared to our peers, funding awarded per year, number of proposals normalized by full-time equivalent faculty, number of center-level proposals
R.8.2 Identify other relevant metrics
Provide high quality, innovative education to future intellectual leaders and technical trailblazers

The Department of ECE at Carnegie Mellon has long had a transformative role in engineering education and curriculum innovation. The “Wipe the Slate Clean” pioneering approach to undergraduate ECE education initiated in the early 1990s and the innovative approaches to class instruction have solidified our department’s reputation in the education arena. However, engineering education is currently undergoing a revolution in how academic institutions facilitate the learning process and how they are engaging with students on a global level. These are opportunities our department is tackling while honoring our commitment to quality and distinction in education. Likewise, the education of tomorrow’s technical leaders cannot stay in the limited realm of standard technical curriculum, but must provide holistic formative training linking education with business and innovation, humanities, social sciences and the arts. In a global society, cultural understanding, knowledge of social dynamics, language proficiency and a continuous thirst for learning are indispensable for the technical leaders that the ECE Department seeks to educate and inspire.

STRATEGIES AND ACTIONS

E.1 Provide an innovative, holistic curriculum for the next decade
   E.1.1 Reevaluate current curriculum from the points of view of content, delivery and societal needs for the next ten years
   E.1.2 Ensure that presentation and discussion of the fundamental concepts is preserved, even in the context of new methods of presentation and delivery and an increasing trend toward application-driven courses
   E.1.3 Use pedagogical methods that inspire thinking and creativity
   E.1.4 Develop mechanisms that enable the curriculum and teaching methods to respond and adapt quickly to newly-emerging technologies
   E.1.5 Provide students with meaningful assessment of their abilities and work and investigate methods for doing so in large classes
   E.1.6 Promote teaching that emphasizes fundamental concepts, principled engineering solutions, teamwork and interdisciplinary collaboration
   E.1.7 Organize and teach courses in a fashion that promotes successful outcomes for students representing all demographic segments of the class
   E.1.8 Invest in innovative approaches for holistic education including humanistic, introspection and development, in addition to core engineering disciplines
   E.1.9 Improve students’ written, oral and visual communication skills
   E.1.10 Promote a culture of integrity and ethical behavior through incorporating engineering ethics into our teaching and developing a repository of examples of the consequences of ethical and unethical choices in engineering practice
   E.1.11 Understand and mitigate factors that may lead to unethical behavior

E.2 Provide high-quality instruction based on the science of learning
   E.2.1 Create a comprehensive plan to teach the teachers
   E.2.2 Create best practices for junior faculty as they start teaching
E.2.3 Develop a process for training and mentoring teaching assistants and interns and assessing both their performance as well as the quality of their educational experience
E.2.4 Create assessment tools beyond Faculty Course Evaluations to evaluate teaching quality
E.2.5 Promote innovations in teaching that improve learning outcomes

E.3 Provide opportunities for student research at all levels
E.3.1 Create a clearinghouse of available projects, both internal and external
E.3.2 Establish travel grants for students to attend conferences
E.3.3 Assemble faculty/alumni/industry teams to come up with relevant projects

E.4 Strengthen the maker, innovation and entrepreneurship culture
E.4.1 Work on providing “maker spaces” for our students
E.4.2 Promote the development of a curriculum that exploits those maker spaces
E.4.3 Use maker spaces as a catalyst for curricular changes

E.5 Provide agile professional Masters programs to anticipate and respond to industry needs
E.5.1 Review and assess the quality of the current Masters programs
E.5.2 Team up with employers to assess which skills are needed
E.5.3 Offer specialized Masters degrees that move with the times

E.6 Leverage our global presence to create agile and creative professionals
E.6.1 Find opportunities to exploit the global campus to create educational experiences that will attract, inspire and excite students and meet the needs of the host community
E.6.2 Monitor the integration of the educational experience and attendant quality throughout the global campus while being sensitive to local environments
E.6.3 Develop strategies to build programs that exploit the strengths of individual campuses, recruit students who are attracted by them and identify ways to fulfill complementary needs using resources available at other campuses, including Pittsburgh
E.6.4 Leverage the global presence to create multicultural teams
E.6.5 Assess the past, present and potential methods for delivering education from a distance in terms of effectiveness and student outcomes
E.6.6 Ensure and plan for developing space needs and technical support for distance courses
E.6.7 Develop methods to either reduce class size in the face of physical limitations or accommodate large classes when there is teaching capacity

E.7 Develop metrics for success to drive and characterize progress
E.7.1 Evaluate faculty effectiveness in student advising and mentoring
E.7.2 Develop metrics to assess whether each student is achieving his/her potential, including underrepresented groups
E.7.3 Evaluate alumni and employer satisfaction to assess whether educational outcomes are being satisfactorily met in a 5-10 year horizon
E.7.4 Survey graduating students and recent alumni to obtain detailed and ECE-specific feedback on their experiences in the department, especially on which aspects of their educational experiences have been most and least effective in realizing their career goals
FIRE: FOSTER, IMPACT, RESEARCH, EDUCATE

The process of establishing our vision and this plan gave us an opportunity to articulate what we value, what we want to achieve and how to hold ourselves accountable. The clarity that comes with establishing a vision is in itself an achievement. We will use this FIRE to clearly plan our actions, to allocate resources and to articulate our vision for the next few years.

*Do what makes your heart sing*
ACKNOWLEDGMENTS

This strategic plan presents our articulated vision and strategic objectives. It is the culmination of feedback and interactions throughout 2014 and 2015 from a number of faculty task forces, monthly faculty lunches, our 2014 & 2015 Faculty Retreats, Alumni Council, student, faculty and staff town hall meetings and various forms of departmental meetings and gatherings. We took a fresh look at all parts of our operations: research, education, societal impact, students, faculty, staff and staff organization, finances, industrial and government relations, alumni network, global campus, external visibility and the working environment. We thank all ECE students, faculty, staff, alumni and friends of ECE, and in particular, the following individuals for their efforts:

Department and staff leadership

• **José M. F. Moura** Philip and Marsha Dowd University Professor and Assoc. Dept. Head for Research and Strategic Initiatives
• **Diana Marculescu** Professor and Assoc. Dept. Head for Academic Affairs
• **Larry Pileggi** Tanoto Professor and Interim Department Head
• **Meighan Harding** Director of Operations
• **Charlotte Ambrass** Associate Director of Finance and Sponsored Research
• **Leona Kass** Associate Director of Academic Affairs
• **Tara Moe** Associate Director of Graduate Affairs
• **Christina Cowan** Executive Assistant and Administrative Services Manager
• **Krista Burns** Communications Manager

Committee chairs

• **James Bain** Graduate Studies
• **Lujo Bauer** Junior Faculty
• **Franz Franchetti** Future of Computing & Communications
• **Diana Marculescu** Curriculum
• **Radu Marculescu** Undergraduate Studies
• **Tamal Mukherjee** Graduate Admissions
• **Bill Nace** Program Assessment
• **Larry Pileggi** Faculty Search
• **Aswin Sankaranarayanan** Seminars
• **Dan Siewiorek** Awards
• **Tom Sullivan** Undergraduate Advising
• **Don Thomas** Facilities

Global campus leadership

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<th>Shawn Blanton</th>
<th>Bruce Krogh</th>
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Alumni council

• **Nikhil Balram**
• **Anirudh Devgan**
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