

Carnegie Mellon Engineering Strategic Plan

Transformative Education and Pioneering Research for Real and Enduring Good

March 2023



A Message to our Community

We are excited to present our 2023 Strategic Plan, “Engineering Impact: Transformative Education and Pioneering Research for Real and Enduring Good.” The process to develop this plan began in Spring 2022 with an intensive series of engagements aimed at hearing from our faculty, staff, students, and community members. We are proud to say that this process connected us with more than 500 people across our community to create a shared vision for the future.

This Strategic Plan also benefited from the successes of and lessons learned from the College’s 2014 Strategic Plan, “Expanding Collaboration, Empowering People, Elevating Impact.” The 2014 Plan marked our first College-wide strategic planning effort, an important step forward. While that plan provided a strong foundation for new College-wide initiatives, the global and academic landscapes have changed substantially since its creation. The COVID-19 pandemic interrupted life across the world and posed a serious challenge to higher education. In response, we banded together to teach, learn, research, and work in new ways.

This plan presents specific directions that I believe will produce outsized benefits for the College, driving us toward our overall goal of delivering transformative education and conducting pioneering research that makes a positive impact in our community and around the world. It is not intended to document all the work we now do, or will do, in the next five years.

It is the product of input from a community that is results-oriented, leads from a global perspective, is deeply collaborative, respects and values everyone, and acts with integrity. Our people are our most important asset and are collectively a community with the capacity and the drive to deliver education and conduct research that truly makes the world a better place. Advanced Collaboration®, our way of working together in tight-knit teams of determined experts who leverage interdisciplinary insights, complementary skills, and different perspectives to drive change, is part of what distinguishes us from our peers.

In executing the plan, we realize that resources are finite and that new initiatives can only be accomplished with additional human and financial resources, so we must prioritize what to do, and critically, what not to do. Ongoing work will be done during the lifetime of the plan to develop and execute implementation plans, and to monitor our progress.

To conclude, I sincerely thank all those that have contributed to the development of this plan, some of whom we have identified and acknowledged in the final section of this document. What is documented here represents the work of many, and I would like to especially thank the strategic planning co-leads Prof. Shelley Anna and Prof. Elizabeth Holm, the strategic planning working and steering committees, the academic department heads/directors and research directors, and those that participated in theme groups and the fall strategic planning retreat.

The future is bright for CMU Engineering and I look forward to working with our community of faculty, staff, students, alumni, partners, and friends as we implement this plan.



A handwritten signature in blue ink, which appears to read "Will Sanders".

William H. Sanders
Dr. William D. and Nancy W. Strecker Dean, College of Engineering
March 2023

Our Shared Aspirations

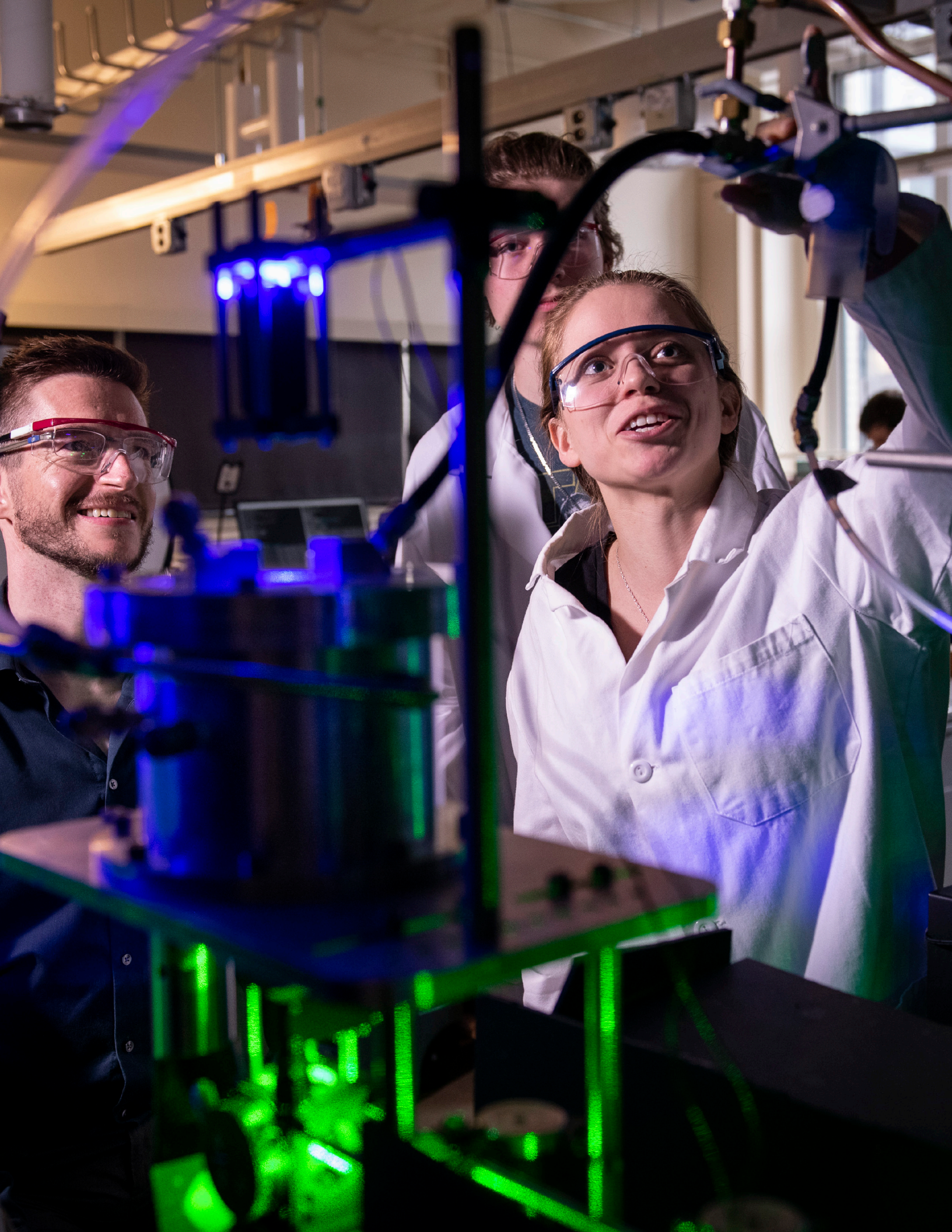
We are a diverse community of students, faculty, staff, and alumni working together to advance engineering knowledge and endeavoring to create transformative change in the quality of life around the globe. The tagline of our vision, “Together, we shape the future for real and enduring good,” is inspired by our founder, Andrew Carnegie, and what drives us today.

Real and enduring good includes educating and mentoring the next generation of engineering leaders, conducting foundational research that leads to major technological breakthroughs, solving complex global problems through impactful research, and creating opportunities for fulfillment and growth for our community.

From its inception in 1900, the heritage of CMU’s College of Engineering has been defined by a pioneering spirit. Our history is marked with taking smart risks that lead to bold innovations. These innovations drive our reputation as a globally preeminent engineering college.

We prize our highly interdisciplinary and collaborative culture, as well as our tradition of hands-on learning and research. We focus on work that has a positive societal impact, and our global presence and mindset drives our perspective.

We welcome all to become members of our community, and we treat each other with respect and consideration. Our values are born out of more than a century of experience and growth and represent the culture in which we do our work.



Our Vision

We educate and innovate to expand the boundaries of engineering, address societal challenges, and create engineering leaders around the world.

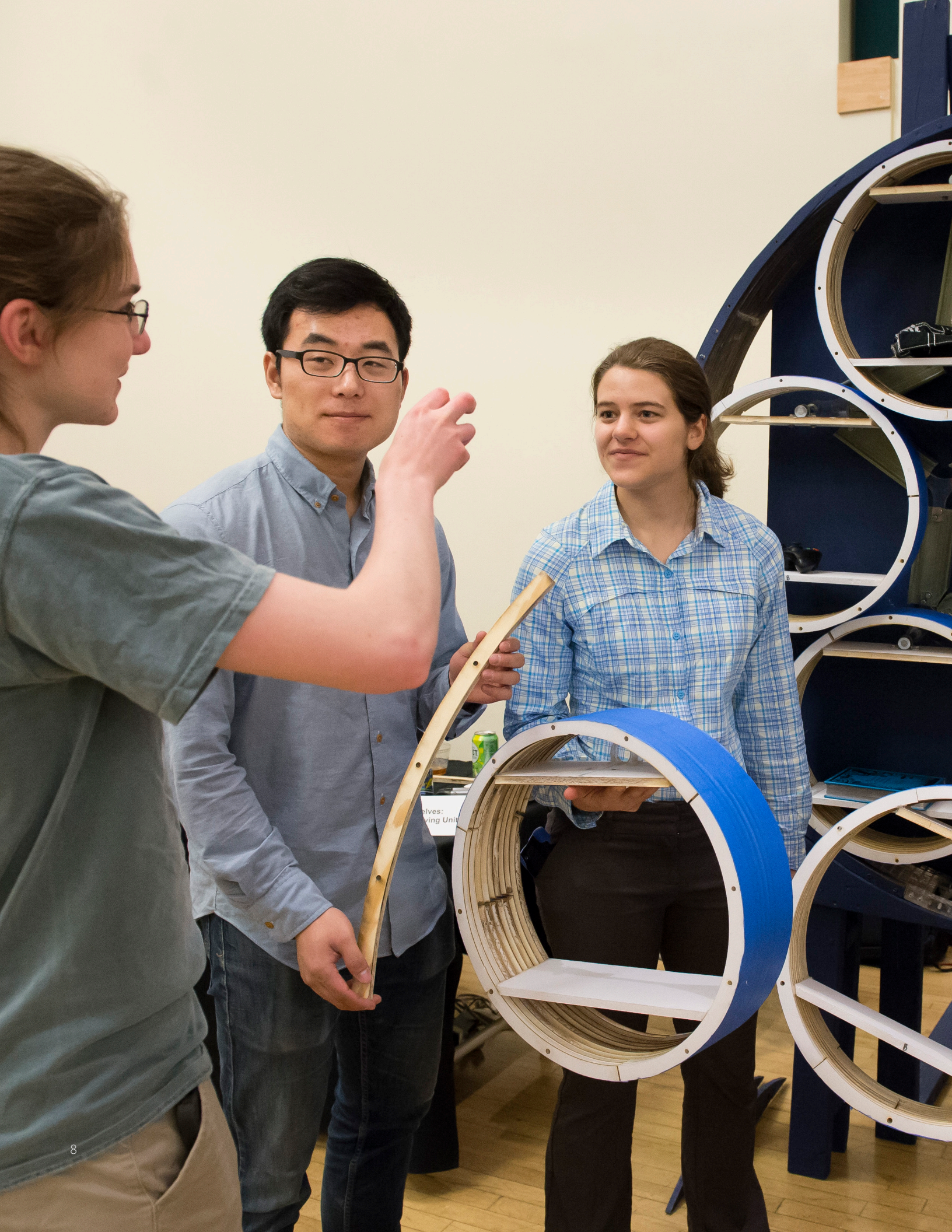
Together, we shape the future for real and enduring good.

Our Mission

We will build and sustain a global community of engineering leaders to achieve real and enduring good by providing impactful educational experiences, performing pioneering research that spans from exploration to realization, and creating an environment where every individual thrives.

We do this with a commitment to upholding a collaborative, interdisciplinary, and inclusive culture that strengthens and unites our College, integrates activity across multiple geographic locations and academic disciplines, and engages and invigorates our diverse





Our Values

We are results-oriented.

Aim high and tackle significant problems.

Drive toward results with intention.

Dedicate ourselves to outcomes that positively impact the world around us.

We lead from a global perspective.

Seek to improve the world for all.

Educate leaders to contextualize their impact.

Transcend the barriers of boundaries and distances.

We are creative through collaboration.

Gain insight through wide-ranging perspectives.

Listen deeply and adapt.

Connect across boundaries, disciplines, and borders.

Never stop innovating.

We respect and value everyone.

Value our welcoming and inclusive culture.

Build a community that enables everyone to excel.

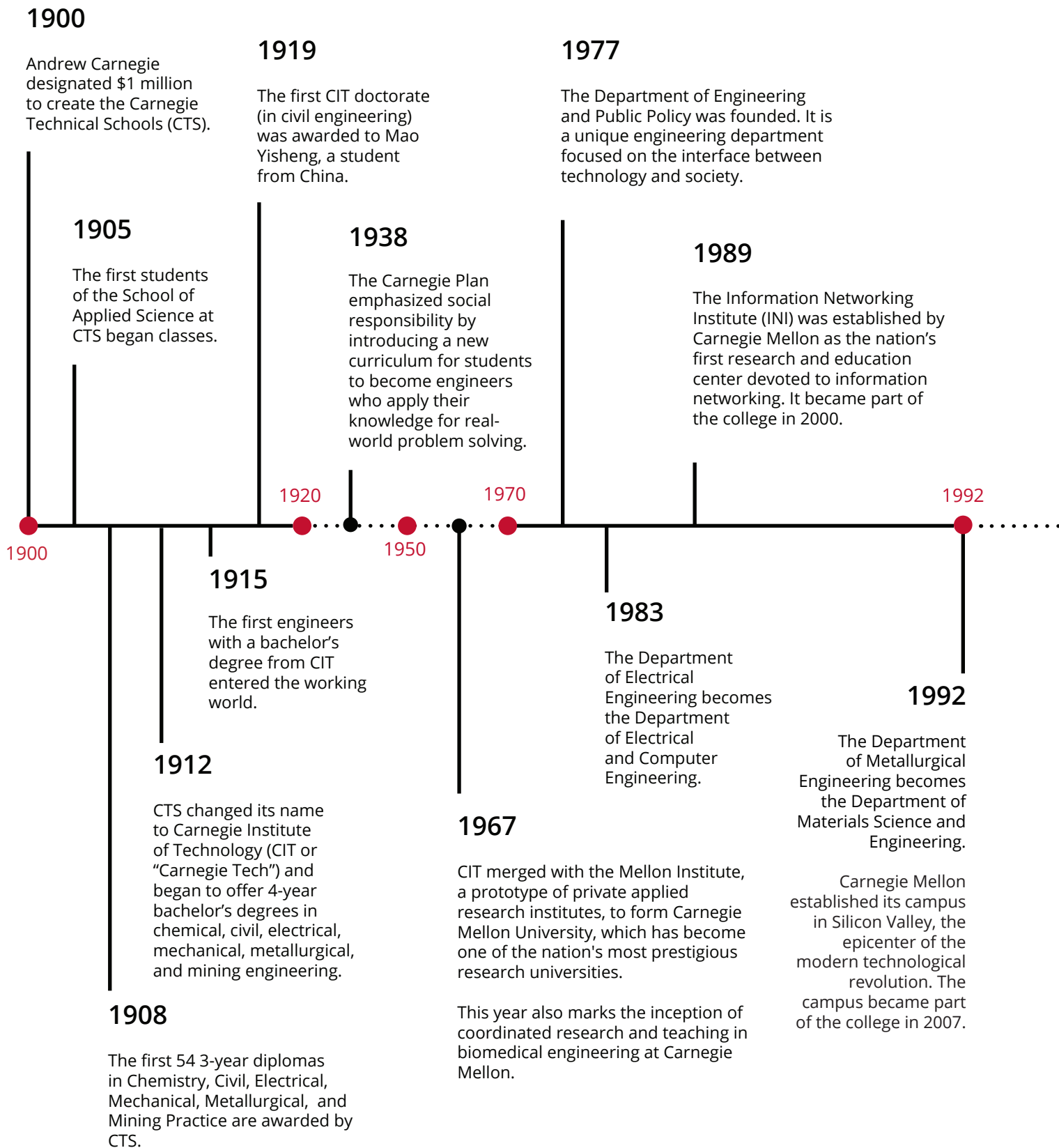
We act with integrity.

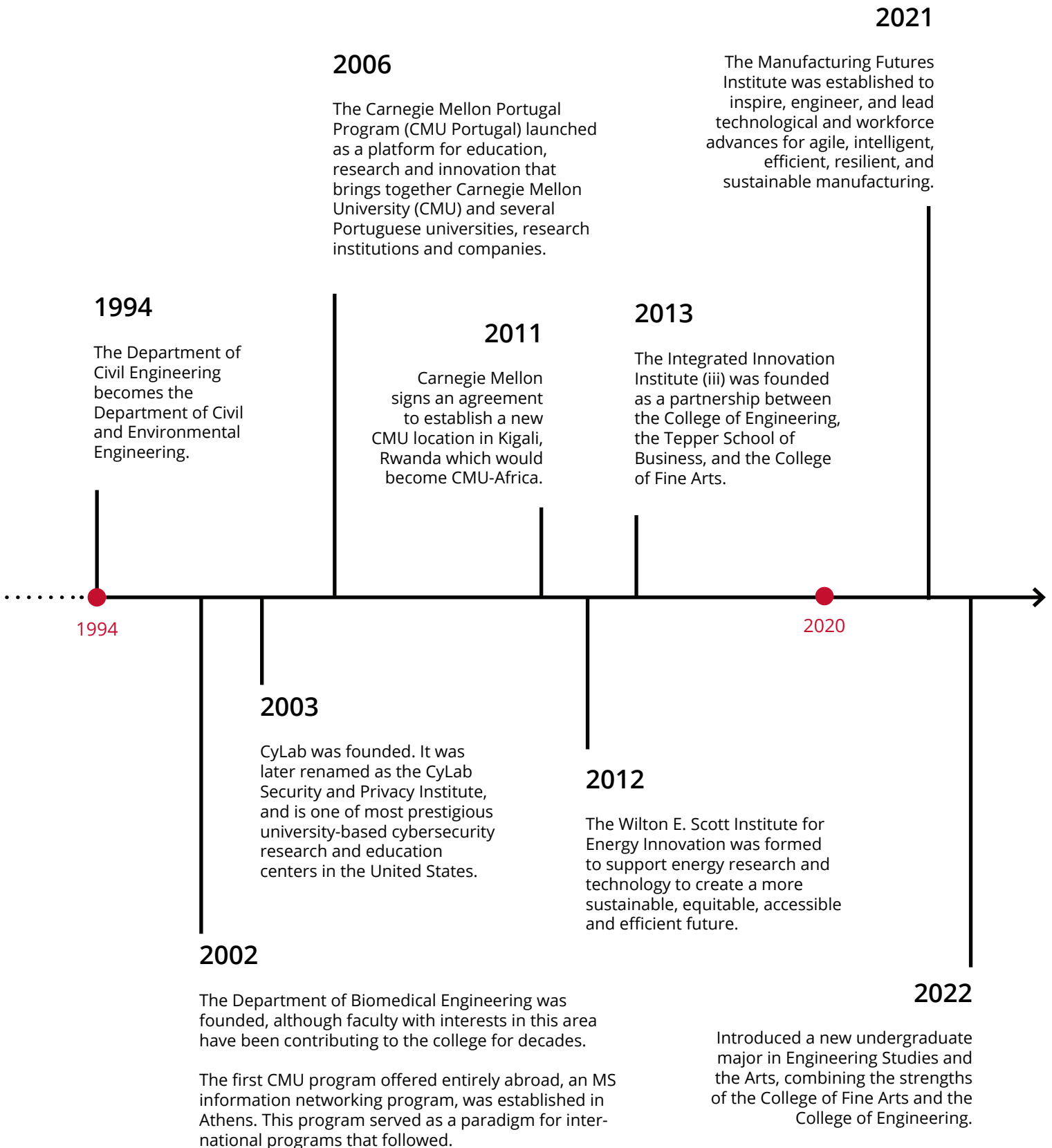
Bring our authentic selves to every interaction.

Trust others and are trustworthy.

Hold every facet of our actions to the highest ethical standards.

Growth of CMU Engineering over Time





Strategic Goals

The following pages introduce and describe each of our four strategic goals and the corresponding actions that will help us realize our vision and mission, while living according to our values. The goals below enumerate our strategic focus for the next five years in the following areas: Research, Education, Global Presence and Mindset, and People and Culture. These goals are not inclusive of all the important work we are undertaking and will continue to undertake. Instead, they represent specific initiatives we have identified for their potential to produce outsized benefits for our global College of Engineering community, University, and world.

Research

Conduct research collaboratively, from the foundational to the applied, to solve large-scale and complex problems.

Education

Strengthen our educational offerings by embedding key mindsets and contexts in our curriculum and creating new interdisciplinary and modular offerings to educate engineering leaders.

Global Presence & Mindset

Strengthen our engagements globally – transcending geographic distance – to advance our global mindset, tackle global research challenges, and drive local and global economic vitality.

People & Culture

Make CMU Engineering a place where all community members can thrive.





Research

Conduct research collaboratively, from the foundational to the applied, to solve large-scale and complex problems.

CMU Engineering has a long, strong tradition of research excellence that is built on a foundation of collaboration. Our collaborative and interdisciplinary culture catalyzes new research directions and nourishes established ones, and our bottom-up approach empowers every researcher to identify and pursue the challenges they find most compelling. The results speak for themselves: CMU researchers' interdisciplinary approach tackles problems from the foundational to the applied, resulting in global contributions. We are recognized for the depth, breadth, and impact of our work. This ethos is core to who we are, and we will continue to encourage research of all styles and scales, recognizing that innovation comes from both curiosity- and use-inspired work.

Acknowledging that the most compelling societal problems are interconnected and complex and that our desire is to have impact on a global scale, we must effectively support center-scale efforts that involve multiple investigators, disciplines, and institutions. To become even more impactful in addressing highly challenging societal problems, we will build our capability to conduct research at scale. This requires addressing the complex challenges that require the perspective of many disciplines, connecting CMU Engineering with other colleges, institutions, and new partners, and providing the infrastructure to execute effectively at the center-scale level.

We will achieve this goal with strategic investments in research team leadership, our administrative research support ecosystem, our research enterprise, and entrepreneurial activities that translate research to practice.

Strategic Actions for Research

Support a culture of research team leadership, empowering faculty and other investigators to pursue research at scale.

To encourage investigators to pursue large-scale research opportunities, we must incubate and sustain a culture of research team leadership. This career-spanning effort will identify potential team leaders in strategic research areas, offer training to develop their leadership skills, and provide resources to lead large-scale proposals. Training will enable leaders to employ the science of teams, which elucidates how complex, collaborative research team composition, effective team management, and mutually beneficial collaboration can lead to more impactful outcomes. A key, ongoing activity will be offering forums for team leaders to gather, network, and cultivate big ideas. To elevate strategic research areas to the college level, we will create strategic advisors who will evaluate, develop, and facilitate strategy for pursuing research in targeted areas of potentially significant research growth for the College.

Create the structures and expand resources to support large-scale project execution.

Executing large-scale research projects is technically and administratively complex. Our approach to doing this will include developing a culture that values and supports postdocs and research scientists who will be critical for executing and delivering on the goals of a given project. Supporting connection, mentoring, and professional development for postdocs and research scientists will be a key focus. We will also provide people and structures to support interdisciplinary research centers by assisting with reporting requirements, finances and accounting, cost-sharing that minimizes burden on individual PIs, increasing the pool of Ph.D. students and postdocs, and coordinating cluster or joint hiring in strategic areas.

Enhance the proposal-development ecosystem to increase the scale of projects won.

The Engineering Research Accelerator has made significant strides in supporting the proposal development process. Scaling up to increase the number of successful center-scale research programs will require growing the size and scope of proposal support and enhancing the research incubation effort, including reimagining the moonshot program. We will increase our efforts to help early career faculty jumpstart their research programs by democratizing access to opportunities through sponsorship of junior faculty within senior faculty knowledge networks. We will continue to assist faculty to implement broader impact and outreach components of awards, and continuously cultivate mutually beneficial research relationships with partners and community.

Develop structures and resources for entrepreneurial activities to increase start-ups, spin-offs, and licensing opportunities.

To translate research success into real-world impact, we will develop an infrastructure to provide entrepreneurial faculty, staff, and students with opportunities to leverage their ideas into new companies and/or licensing opportunities. Approaches could include creating leave programs for faculty and staff and creating strategic partnerships with entrepreneurship programs within and outside the University. An important effort will be to ensure that knowledge and access to entrepreneurship infrastructure and programs is broadly disseminated through mentorship and sponsorship of early career investigators.

See People & Culture goal to read about other strategies for enhancing our culture of leadership. See Global Presence & Mindset goal to read about other strategies for expanding our research enterprise. See Global Presence & Mindset goal to read about other strategies for developing entrepreneurial activities.



Research in Action

Major Research Institutes and Center-Scale Efforts

The College of Engineering manages three major campus-wide research institutes that focus on interdisciplinary areas of critical societal importance: the CyLab Security and Privacy Institute, the Manufacturing Futures Institute, and the Wilton E. Scott Institute for Energy Innovation. These Institutes catalyze foundational and applied research and provide infrastructure to nurture large multi-investigator efforts.

In addition, there are more than twenty other center-scale efforts underway in the College, spanning and expanding the boundaries of engineering through collaboration across departments, colleges, and with industry, government, and other universities.

Engineering Research Accelerator

The Engineering Research Accelerator has enabled faculty to realize their research goals since 2015 by identifying new research areas and funding opportunities, offering non-technical and administrative expertise for proposal development and project execution, and providing resources to support development of new research areas and teams.

The Engineering Research Accelerator has been instrumental in developing, winning, and executing large-scale interdisciplinary research programs, including the AFRL D3OM2S Center of Excellence; the NASA HOME Space Technology Research Institute for Deep Space Habitat Design; NSF AGEP Project ELEVATE; and the National Network for Critical Technology Assessment (NSF); among others.

Research for societal impact

CMU Engineering faculty develop engineering systems that promote greater societal equity, such as work in Engineering & Public Policy examining how engineering design and policy affects communities. Our work also involves embedding inclusivity in engineering research, for instance by developing systems that work for individuals with different anatomies, skin color, and hair texture.



Education

Strengthen our educational offerings by embedding key mindsets and contexts in our curriculum and creating new interdisciplinary and modular offerings to educate engineering leaders.

Education has been at the core of CMU Engineering since its beginning, when Andrew Carnegie envisioned providing educational opportunities for working class people to improve their lives and communities. The Carnegie Plan, initiated in 1938 by President Robert Doherty, laid the foundation for our culture of interdisciplinarity and problem-solving. We continue this legacy today by helping students gain depth in one or more major engineering disciplines, along with breadth across sciences, humanities, and fine arts. Our world class engineering education earns us a ranking among top engineering colleges for both undergraduate and graduate education.

We recognize the continued evolution of the engineering and higher education landscapes, which necessitate new mindsets critical for future engineering leaders. These key mindsets involve the ability to innovate with ethical, social, cultural, entrepreneurial, and economic contexts in mind and to understand the full implications of all things engineered.

To broaden our learning community, we must anticipate new directions in engineering disciplines and take advantage of new modes of education. Focusing on these priorities will enable us to better educate the next generation of engineering leaders and increase access to our world class education.

We will achieve this goal with strategic investments to embed key mindsets within existing programs, create new educational offerings in emerging disciplines, and introduce new modular and online modalities of teaching.

Strategic Actions for Education

Augment our curricula to create engineering leaders who solve problems cognizant of their full context, keeping ethical, social, cultural, entrepreneurial, and economic contexts in mind.

In order to solve society's most pressing problems, engineering leaders must engage interdisciplinary perspectives and develop solutions with ethical, social, cultural, entrepreneurial, and economic contexts in mind. A global mindset that recognizes the uniqueness and multiplicity of local contexts is also important. To integrate these mindsets into our curricula, we will create educational modules and experiential learning opportunities and incorporate them into courses across programs and levels, including in the first-year undergraduate core. Upper-level undergraduate and graduate students will be encouraged to further develop these mindsets through enhanced course content, projects, and extracurricular programs. To support these efforts, we will provide training and mentorship for faculty in inclusive and globally aware teaching practices.

Coordinate and collaborate across departments to create new educational programs in emerging interdisciplinary areas.

CMU Engineering has a long history of creating unique cross-disciplinary educational programs to ensure our students lead the way in shaping emerging technologies and have the skills necessary to innovate. Most recently, we launched seven AI Engineering master's degrees that share a common core in the fundamentals while focusing on disciplinary applications. Going forward, we will foster the development of additional novel graduate and undergraduate programs such as cross-disciplinary degrees, coordinated core courses, cross-departmental capstones, and broader engineering courses for students outside Engineering. These new offerings will augment our existing depth and quality of education in the more traditional engineering fields.

Create innovative modular educational offerings to reach a wider community of learners.

Modular teaching and learning modalities increase flexibility and access for an interdisciplinary community of learners. Certificate programs that may be stacked to build full degree credentials can augment our flagship residential programs by allowing practicing engineers to upskill in place. Offering these credentials primarily online can enable us to educate a larger group of learners and broaden our global reach. We will support the development of unique modular programming in engineering, including graduate certificate programs in emerging areas like AI Engineering, programs that target professionals who wish to update their skillset, and certificates that allow current undergraduate and graduate students to add complementary skills to their existing programs.

See Global Presence & Mindset goal to read about strategies for global education. See Global Presence & Mindset goal to read about other strategies for innovative educational offerings in a global context.



Education in Action

Innovations in Undergraduate Education

We have developed discipline-specific introductory engineering courses, introduced experiential learning modules in the first two years, built flexible curricula, and established additional majors in Biomedical Engineering and Engineering and Public Policy.

We have also recently introduced a new undergraduate major in Engineering Studies and the Arts, combining the strengths of the College of Fine Arts and the College of Engineering, for students who wish to apply knowledge from both fields to advance the maker culture in novel and creative ways.

Innovations in Graduate Education

We have launched innovative degrees in Energy Science, Technology and Policy, and Engineering & Technology Innovation Management. We have created new AI Engineering degrees that are discipline-specific and teach students how to use AI to design engineering systems in a data-rich ecosystem.

We operate two educational institutes: the Information Networking Institute, offering bicoastal MS degrees that leverage the best of our Pittsburgh and Silicon Valley campuses and their respective ecosystems; and the Integrated Innovation Institute, offering residential and online MS degrees at the intersection of engineering, design, and business.



Global Presence & Mindset

Strengthen our engagements globally – transcending geographic distance – to advance our global mindset, tackle global research challenges, and drive local and global economic vitality.

Since 2002, CMU Engineering has gained substantial experience in operating across the world. In doing so, we have concentrated our efforts on developing engagements where we can maximize the mutually beneficial impact for the College and the communities we serve. Today, we have five major global engagements across three continents and looking ahead, we will continue to strengthen our global reach and perspective. To do so, we will develop programs and activities that transcend the geographic distance between engagements, creating a College with a truly global mindset.

Engineering leaders of the present and future must learn, understand and engage within the local context and wider implications of a problem in order to develop solutions that work in place. This applies to designing everyday products as well as solving the most difficult challenges of this century. Going forward, we will prioritize efforts that elevate and integrate our engagements globally, to increase impact and provide opportunities for all members of our community to develop global perspectives.

To accomplish this, we will connect education and research experiences for students, faculty, and staff across all our locations (including Pittsburgh) while recognizing and leveraging the unique strengths and qualities of each location and community. We will also work to broaden these experiences, involving more of our departments, institutes, and colleges. These unique engagements will expand our education and research programs, help our communities tackle global challenges, and create innovations that improve economic vitality locally, regionally, and globally.

Strategic Actions for Global Presence & Mindset

Integrate educational programming across our engagements to transcend location-based offerings, connect students, and expand global access.

We will devise programs and programming to provide students with opportunities to broaden their perspective and gain insight into other global contexts. Opportunities may include collaborative international capstones and immersive abroad programs. Additionally, we will integrate education across our locations by leveraging existing online tools and content, and creating new infrastructure to increase content accessibility for all of our locations and beyond.

Involve more of our departments and institutes in global activities, broaden the scope of these activities, and collaborate with other CMU colleges to expand global opportunities for students and researchers.

We will encourage departments and institutes to launch or expand programs in locations where they strategically fit, join operations across locations where appropriate, and engage local talent when delivering education and conducting research. We will invite other CMU colleges to engage with us to enhance our impact. By expanding the scope of our global engagements, we will provide a foundation to engage more students and researchers worldwide.

Build new research collaborations across our global engagements to expand and strengthen our research activities.

Connecting unique viewpoints across the world enhances the large-scale, collaborative research required for tackling societal problems. We will encourage and enable global collaboration among our locations that conduct research. To do so, we will be creative in the ways we secure funding for research globally (often involving researchers from multiple locations), provide programs to support the travel of researchers between locations, and develop networks that include other universities globally.

Drive the economic vitality of our communities, their nations, and the world.

Economic development is an important part of our mission at all of our locations. Cognizant of this, we will work with local communities to contextualize their economic realities and partner to find solutions tailored to improve economic prosperity. We will also engage our community of students, faculty, and staff by encouraging activities that bring positive economic impact locally, regionally, nationally, and globally. These efforts will include supporting the open-source, entrepreneurial and public policy activities of faculty and students.

See Education goal to read about other strategies for global education and innovative educational offerings. See Research goal to read about other strategies for expanding our research enterprise. See Research goal to read about other strategies for developing entrepreneurial activities.



Major Global Engagements

Pittsburgh

Serves over 4,000 engineering students in nine academic departments; operates three major research institutes, namely CyLab, MFI, and Scott; and oversees more than 20 center-scale research efforts. Offers six undergraduate majors, 31 master's programs, and nine doctoral programs.

CMU-Africa

Offers three MS Degrees and operates a collaborative research center, start-up incubator, and the Afretec Network.

CMU Portugal

Offers dual doctoral degrees, affiliated Ph.D. programs and advanced training programs; funds large-scale and exploratory research projects; and fosters company partnerships and provides entrepreneurial support.

Silicon Valley

Offers MS degrees through the Electrical and Computer Engineering Department, Information Networking Institute and Integrated Innovation Institute.

Afretec Network

Includes leading African universities across the continent that are led by CMU-Africa; and enables technology-focused universities to work together to drive the inclusive digital transformation of Africa.



People & Culture

Make CMU Engineering a place where all community members can thrive.

We are a community of doers. All of us – faculty, students, staff, and alumni – contribute our skills, experience, and dedication to realize the mission of the College of Engineering. Our interdisciplinarity is our strength: It widens our perspectives and bridges gaps. It is foundational to our excellence, enabling us to meet challenges such as the COVID-19 pandemic with creativity, flexibility, and empathy, and ensure that our community is strong.

It is also important that we identify and create professional development resources to support individuals at every career stage to influence retention, improve job satisfaction, and build a community of individuals that can most effectively fulfill the mission of the college.

Work-life balance is also important for fulfilling our mission and ensuring the well-being of our community. In addition to providing policies that are supportive of individuals and families, we must provide an environment that is inspiring, and where people feel engaged and supported. In the context of the actions of this strategic plan, we must realize that resources are finite. New initiatives can only be accomplished with additional human resources, so we must prioritize, making decisions about what to do, and critically, what not to do.

Finally, we must be intentional in bringing individuals together to build community, to collaboratively address challenges, and to fulfill our mission. Together, these efforts will attract and sustain a vibrant, supportive, and connected community.

Strategic Actions for People & Culture

Provide professional development and mentorship opportunities for staff, faculty, and postdocs to enable them to thrive at all stages of their career.

Supporting our community of staff, faculty, and postdocs throughout their careers requires a comprehensive understanding of the full professional lifecycle, including a recognition of the distinct career trajectories for staff and faculty and an understanding of the varied needs of professionals based on their identities, perspectives, and values. Specific actions will include identifying promotion and leadership tracks for staff, reexamining the faculty tracks, reviewing and revising the Promotion and Tenure process, and developing mentoring and professional leadership programs for all career paths.

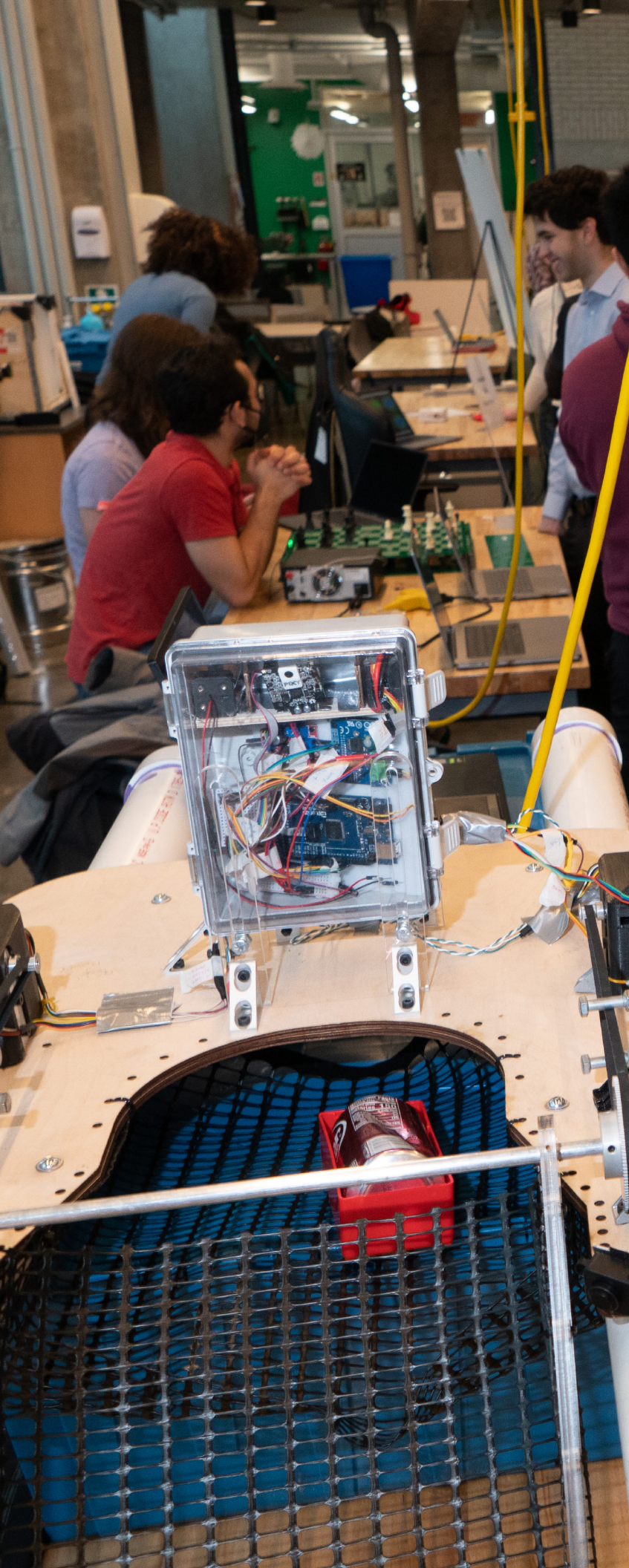
Promote and embrace a healthy work-life balance and work environment to ensure the well-being of our community.

The ability for our community to thrive depends on the well-being of each individual. We will strive to shift the CMU Engineering “stress culture” to a culture that promotes individual health and balance. Actions to promote work-life balance may include: creating flexible work policies for faculty and staff and providing resources for faculty and staff who temporarily take on extra duties. We will work to create an inspiring environment, where people feel engaged and supported. We recognize that our leaders need to model, support and encourage our people to exhibit healthy behaviors in the context of their job expectations and responsibilities.

Create events and programs that convene community members to enhance our culture of Advanced Collaboration®.

The COVID-19 pandemic transformed the way we work, gather, and build community. As we move forward, we will apply lessons learned and find new ways to bring our community of students, staff, faculty, and alumni together to enhance our culture of internal communication and improve collaboration. In doing so, we will collaborate with departments to develop more cross-college programming that takes into consideration flexibility, accessibility, and the needs of all individuals.

See Research goal to read about other strategies for enhancing our culture of leadership. See Communicate our Achievements goal to read other strategies for enhancing internal communication



People & Culture in Action

Recognizing staff and faculty excellence

The College of Engineering annually honors our staff colleagues for their job performance and dedication to College operations and mission. There are four Staff Recognition Awards: Innovation, Inspirational Leadership, Continuous Excellence, and Spirit, as well as the Burritt Education Award and the Rookie Award.

The College annually honors faculty academic and research excellence. The Tallman Ladd, Casasent, and Fenves Awards honor research contributions. The Teare Teaching and Outstanding Mentoring Awards, and the Dowd Fellowship honor teaching and mentoring excellence. The Outstanding Service and Distinguished Professor Awards honor overall contributions.

Call to Action

This plan builds on our heritage of innovation, collaboration, and excellence to craft a roadmap for the next five years and beyond. We begin with a Vision that expresses our commitment to shape the future for real and enduring good, partnered with a Mission that defines our path forward and shared Values that frame our culture of respect and inclusion.

For each of the core activities of the College – research, education, global presence, and culture – we outline strategic actions to leverage our strengths and blaze new trails. In research, we seek to increase the scale, scope, and technological and societal impact of our work while maintaining our successful bottom-up approach. In education, we look to develop engineering leaders who contextualize their work across ever-widening cultural and disciplinary boundaries. We pursue both goals while extending and expanding our global engagements and ensuring that our community is one where all members can thrive.

We embark upon this journey from a strong foundation: over 120 years of education and research at the highest levels, sustained by a global and diverse community. Now it's time to write the next chapter. There is a place for every member of the College community within these strategic goals. We invite you to join us to shape the future of the College – a future dedicated to creating real and enduring good for all.



Acknowledgements

This strategic plan is the culmination of 12-months of intensive engagements that connected with students, staff, faculty, alumni, and leaders from across the College. We heard from a broad cross section of over 500 people and engaged with representatives from all of our global locations. We greatly appreciate everyone who participated, as none of this would be possible without your collaboration and support. We are grateful for the time and effort you have all put into making this plan a reality.

CMU Engineering would like to thank the following individuals for their contribution to this important effort:

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Larry Pileggi, Tanoto Professor and Coraluppi Head of Electrical and Computer Engineering

Acknowledgements

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Gauri Joshi, Associate Professor, Electrical and Computer Engineering

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Lisa Kulick, Senior Manager of Communications, Mechanical Engineering

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The College was assisted in the strategic planning process by Brightspot Strategy.

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