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Weaving Students into Engineering Versus Weeding Them Out: A Framework for Institutions

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Weaving Students Into Engineering, not Weeding Them Out: A Framework for Institutions

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Outline

- **The Weed-Out Philosophy**
- **Weed-Out Practices & Approaches**
- **Why and Why now?**
- **Action Plan, Draft Framework & Next Steps**
- **Questions?**

The Engineering Weed-Out Philosophy

For much of its history, engineering has worked to weed out all but the *perceived* brightest and best, with the belief that the majority of students did not have what it takes to make an engineer.[1,2,3,4]

We have broadened our view of which students have potential to become engineers and dropped some of the more overt practices designed to weed out, but *many of the structures, policies, mindsets, traditions, and approaches used in engineering education today still perpetuate the weed-out philosophy.*

1. Smith, K., and A. Waller, "New Paradigms for Engineering Education," adapted from Smith, K.A. and Waller A.A., 11007, After word: New paradigms for college teaching. In Campbell, W.E., & Smith, K.A. (Eds.). New paradigms for college teaching. 1997, Edina, MN.

2. Felder, R.M., "Engineering Education: A Tale of Two Paradigms," https://www.engr.ncsu.edu/wp-content/uploads/drive/196QvnYsMz9QawFvoJwRfed8nXFGeVt7G/2012-TwoParadigms.pdf

3. Godfrey and Parker, "Mapping the Cultural Landscape in Engineering Education," JEE, 5, January 2010.

4. Arnaud, C., "Weeding out inequity in undergraduate chemistry classes," Chemical & Engineering News, 98 (34), September 2020.

How Does Weeding Out Show Up?

In how we recruit, admit, retain, and graduate students! Preparation & background are a consequence of **opportunity**, not ability:

- family wealth, education, and social status
- higher quality K12 education
- stronger math and science preparation
- K12 extracurricular experiences
- family legacies of college-going that understand how to prepare for and get admitted to selective institutions/programs
- Tutoring, SAT/ACT prep courses, and repeated test-taking to boost scores

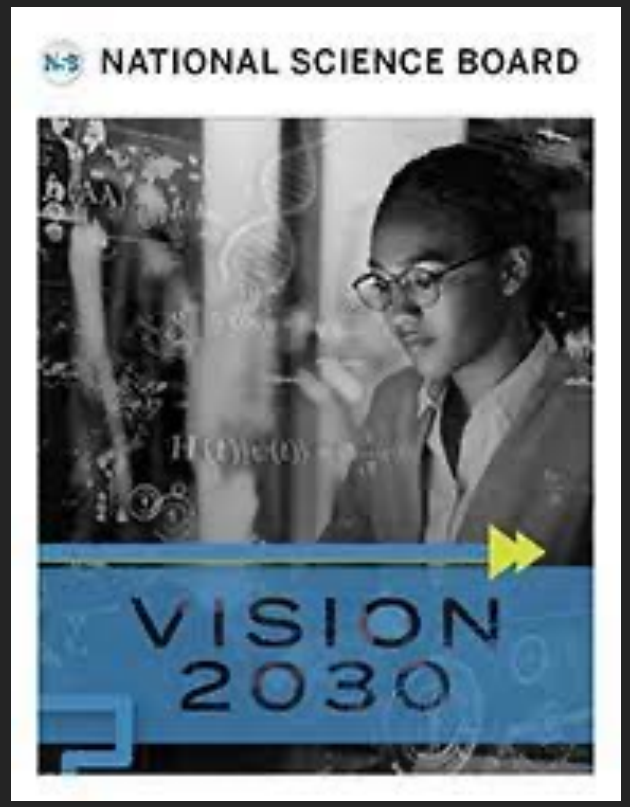
Our system is designed to filter for opportunity.

How Does Weeding Out Show Up?

- Expecting stellar background knowledge of all students
- Curving grades (which forces some people to flunk, not matter how much they know)
- Cramming in too much material too quickly (with little depth, conceptual mastery)
- Heavy focus on memorization and rote problem solving
- Heavy focus on theory with little application or context
- Primary reliance on lecture with no hands-on, team-based activities or application experiences
- One-and-done grading that doesn't provide opportunities to learn and grow

The Weave In Philosophy

- It’s the right thing to do.
- It is time update our notions of teaching and learning. *We know better so we have to do better.*
- We must create student-centered cultures that embrace both the assets that students bring with them to college, together with personalized pathways and on-ramps that foster success and persistence versus forced attrition.



For the Science & Engineering Workforce to represent the US population in 2030:

- the number of women would have to double
- the number of African Americans would have to increase by 2.5 X
- the number of Hispanics would have to triple

National Science Board, Vision 2030 Report, May 2020, https://www.nsf.gov/nsb/publications/2020/nsb202015.pdf, accessed April 20, 2021.

US College Student and Faculty Diversity

At the current pace of change: it will take 300 years for US college students to reflect the % of Native Americans and Blacks in the US population.

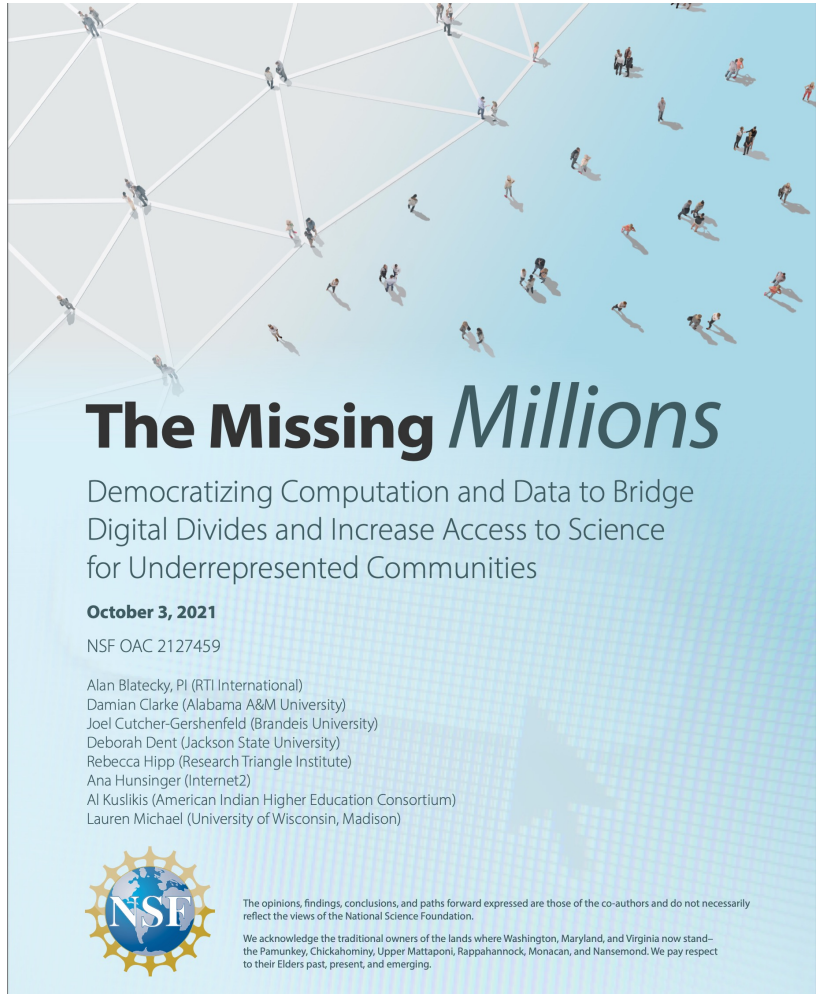
It will take more than 1,000 years at the current pace to reach parity with regard to faculty diversity for all US universities.

R1 institutions will never reach faculty diversity parity at current rate of change.

Adedoyin, O. “Despite Renewed Commitment to Diversity, Colleges Make Little Progress, Report Says,” The Chronicle of Higher Education, July 18, 2022.

Declines in Population & College-Going

We are in the midst of a two-decade decline in the US birth rate, with fewer & fewer high school graduates each year. At the same time, we see increases among college-going students in populations engineering *struggles* to attract, together with *declines* in the populations we typically attract.



Grawe, N. Demographics and the Demand for Higher Education, Johns Hopkins Press, 2018.
Belkin., D. ”A Generation of American Men Give Up on College: ‘I Just Feel Lost,’ “ The Wall Street Journal, September 6, 2021.

Why & Why Now?

We aren’t attracting & retaining historically underrepresented students in engineering or benefitting from the innovation they bring. We are facing huge increases in workforce needs and a declining population in the US. We have to figure out how to educate the students we have now, not those we had 20 years ago.

Conclusion?

Taken together – broadening both access and notions of success is *critical* to the future of engineering and engineering higher education.

It's time to welcome the nation's diverse array of students INTO engineering and provide the support and thriving environments + experiences that empower them to become outstanding engineers.

It is time to stop expecting college-ready students and become student-ready colleges.

Daniel Greenstein, NSF SSTEM Panel, 2019 Conference

It’s NOT about lowering standards or quality of graduates.

It’s about setting appropriate expectations and helping students meet those expectations

versus

expecting students to walk in the door already possessing the knowledge, skills and background required to do so.

Weaving Students In- Not Weeding them Out of Engineering Initiative

Goals:

- Enlist a cohort of national experts & stakeholders – across the engineering spectrum – to realize meaningful, significant improvement in the number & diversity of engineering graduates in the US through use of recruiting, admissions, retention best practices.
- Synthesize research & best practices to identify core initiatives that support success
- Identify programs that work for specific student audiences
- **Communicate evidence-based practices and partner with institutions to implement these.**

Action Plan

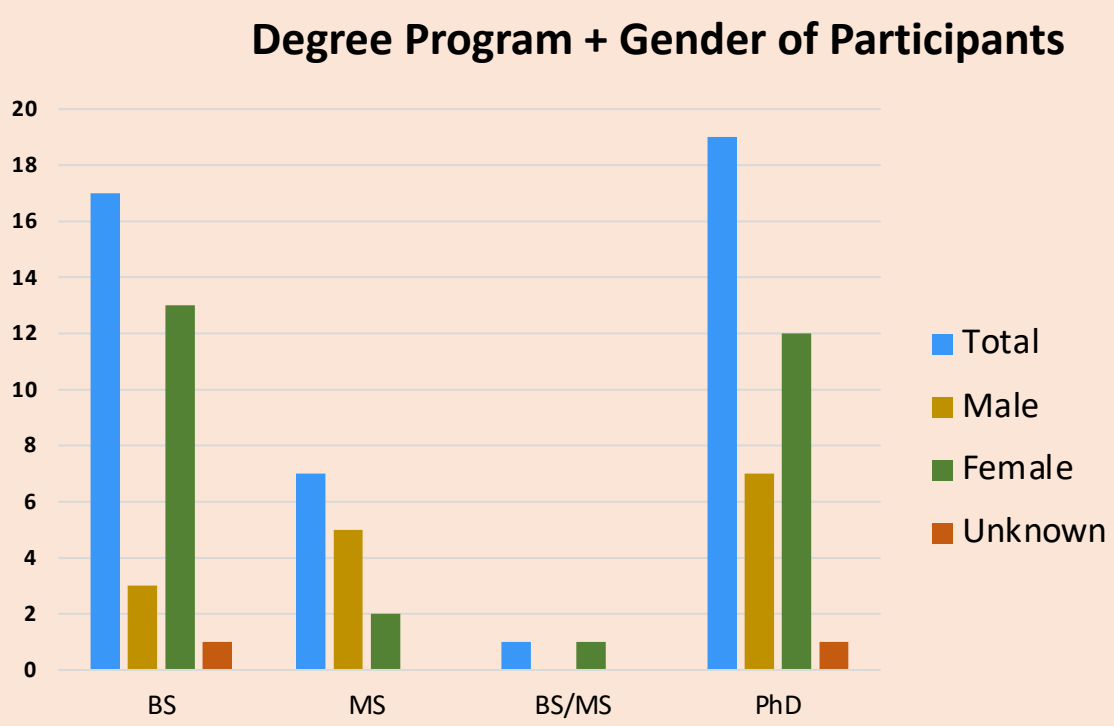
- 4 brainstorming sessions with national experts in Spring 2022 to identify successful programs & initiatives, as well as areas for improvement
- Conversations with the Engineering Societies Education Pathways Roundtable Task Force in 2022 on ways to partner once the project reaches implementation stage
- Engineering Research Visioning Alliance-ASEE co-sponsored Listening Session in October 2022 to hear voices of engineering students
- NSF-funded NAE-ASEE Conference in October 2022 to develop a framework to support student success in recruiting/admissions, onboarding, skills development
- Pursuit of additional funding in 2023-24 to further develop the framework and engage partners for national roll-out & implementation

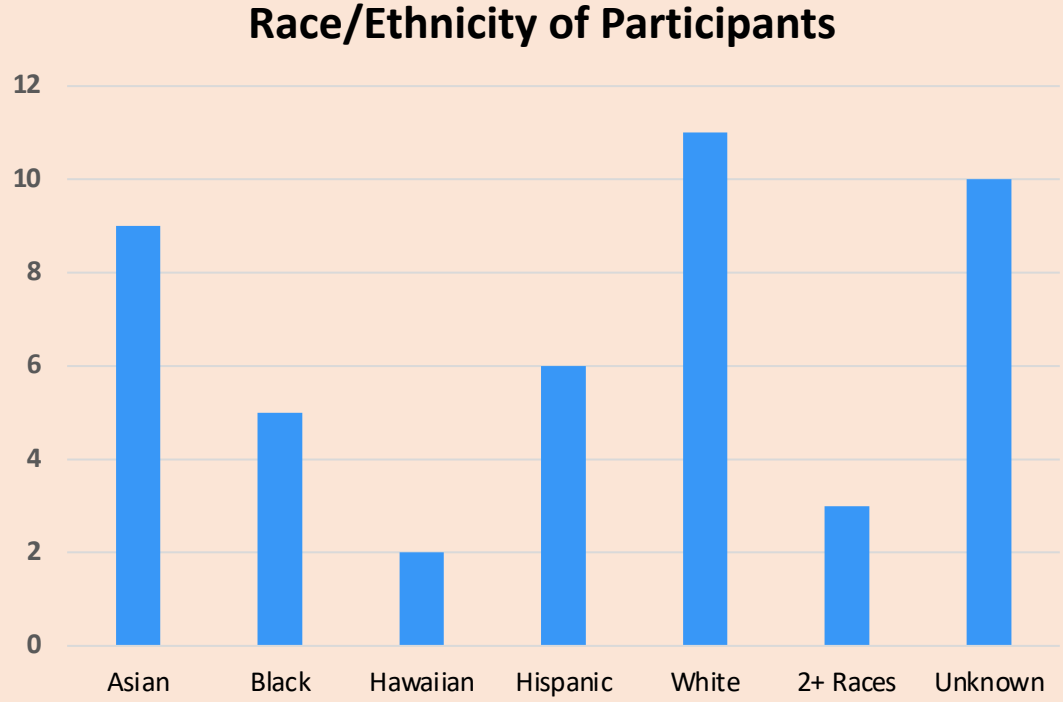
4 Brainstorming Sessions

- 30 engineering education experts from around the country, nominated by peers
- Diverse range of institutions, roles, & areas of expertise represented
- Participants provided feedback on overview, rationale, objective, and vision.
- Participants discussed strengths, successes, strategies & approaches that advance this vision, as well as areas of improvement & opportunity for weaving students into engineering.
- **Common themes were identified across all four sessions: recruiting/admissions, onboarding, student skills development**

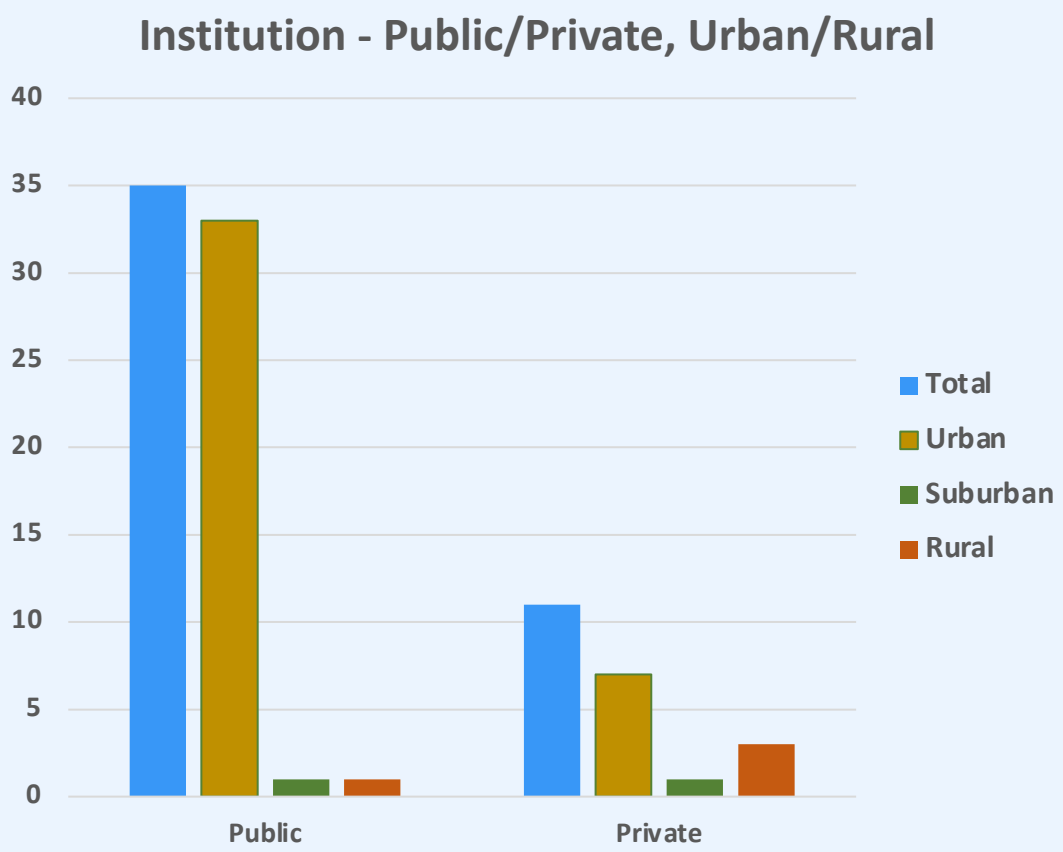
ERVA-ASEE Listening Session

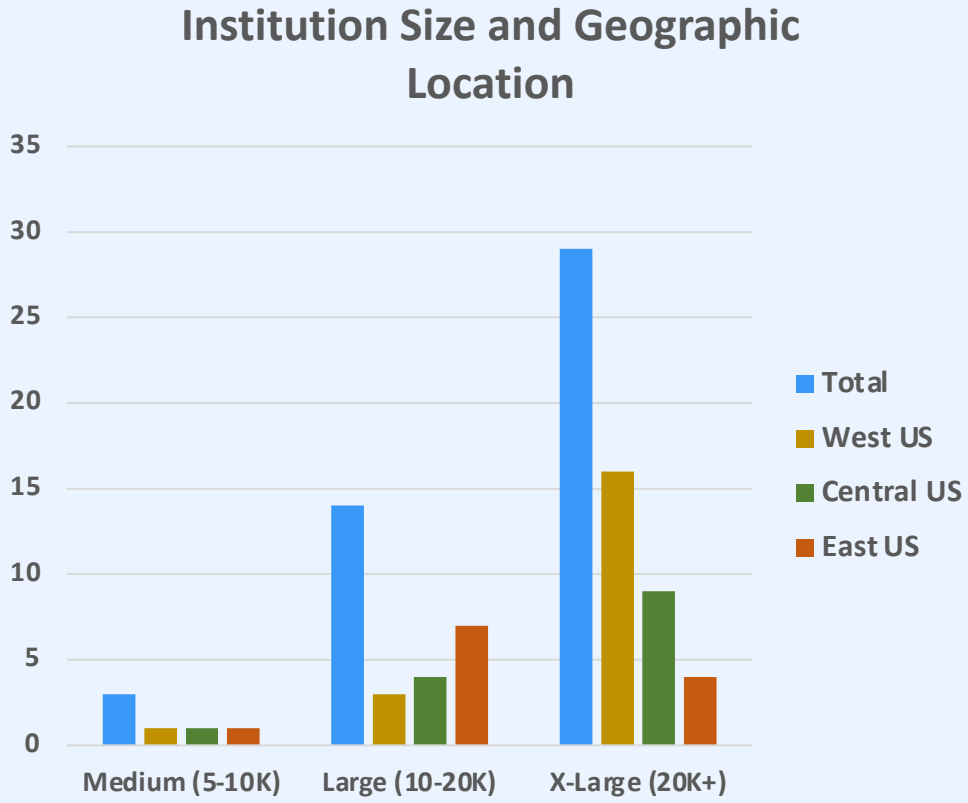
3-hour virtual session with 46 invited students





ERVA-ASEE Listening Session





ERVA-ASEE Listening Session Questions

1) What were the strengths of your early higher education/post-secondary experience? What supports helped you the most?

2) What barriers do post-secondary students face when participating in, experiencing, or learning about STEM concepts? What are your coping mechanisms to overcome these barriers?

3) How might these barriers further motivate or challenge students' pursuit of engineering in post-secondary education?

4) How could we get research off the pedestal and into something tangible in the real world?

5) How can we do a better way of describing engineering research in a way that students can relate to?

ERVA-ASEE Listening Session

Common Themes from Student Responses:

1) No major differences between the described barriers & opportunities based on educational level.

2. Fundamental human needs (financial, food, shelter security), and mental health support, are critical to student success at all levels.

3. Students consider access to/ability to be a part of an inclusive engineering community (peers, faculty, student organizations) to be valuable.

4. Students desire more opportunities to engage with/have access to industry (including projects) in the classroom.

5. Engineering research can gain traction with better connectivity to the public and K-12 outreach through real-world examples, demonstrations, and accessible communication.

ERVA-ASEE Listening Session

Other Common Takeaways from Student Responses:

1) Quality teaching and faculty who care, are engaged, adaptable, & approachable are key for success.

2. The lack of assistance in figuring out systems, processes, transfer, and how to get help is a major barrier/deterrent.

3. Weed out courses are a problem, as are stress, overwork, burnout, feeling overwhelmed, feeling unseen and unheard.

4. Lack of flexibility in curriculum and course scheduling (for students who work) is a barrier. Working also makes it hard to focus completely on school.

NAE-ASEE WINWO Conference

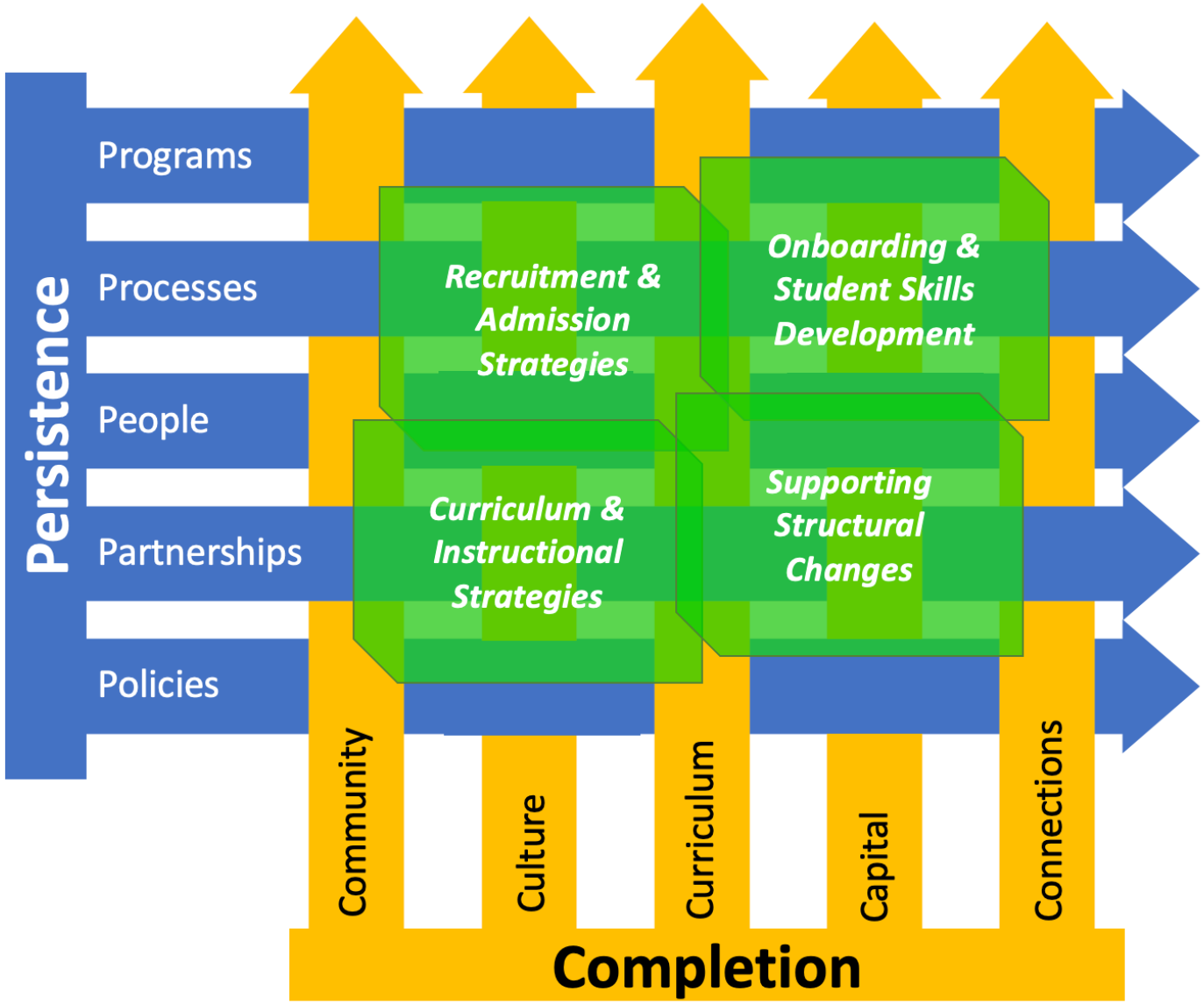
1. 50 engineering education researchers, staff, & professional organization representatives invited to the conference at the NAE.

2. Expert panels featuring evidence-based practices in recruiting/admissions, transfer pathways, historically marginalized groups, onboarding students, & student skills development (focus areas identified in the brainstorming sessions).

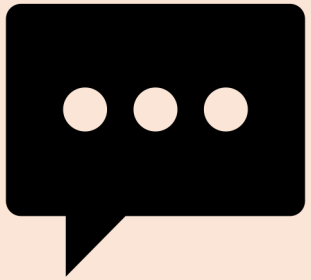
3. 6 breakout groups developed frameworks of best practices in the focus areas for various student audiences that could be reconfigured by different institutions to fit mission, existing programs, & student audiences.

4. Single draft framework emerged, incorporating work of the breakout groups & feedback from the ERVA Listening Session; refined via 4 virtual breakout sessions in spring 2023 and a workshop at the 2023 ASEE Annual Conference.

NAE-ASEE WINWO Draft Framework Overview



Next Steps



- Further development of the draft into a complete framework,
- Possible development of an assessment tool to help institutions identify on what areas of the framework they need to focus, and
- Creation of tool kits of evidence-based practices under each category and thread for institutions to adapt and implement on their own campuses.

We will want to engage a host of different institutions to pilot use of the framework and materials.

Questions?

You can reach me at:

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Vision: To attract, retain, & graduate all of the diverse engineering talent in our nation.

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