ASEE AMERICAN SOCIETY FOR ENGINEERING EDUCATION

William Elgin Wickenden Award

# Beyond Pipeline and Pathways: Ecosystem Metrics

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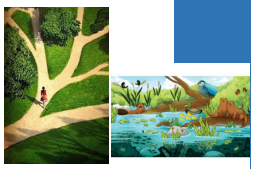
National Science Foundation
WHERE DISCOVERIES BEGIN



MIDFIELD
Multiple-Institution Database For Investigating Engineering Longitudinal Development

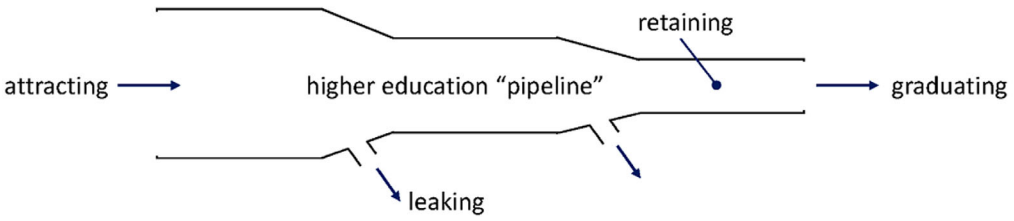
- 11 public universities (most Southeast USA). Expanding to 100!
- 1/9 of USA engineering graduates
- > 1 million unique students over 20 years
- Permits intersectional analysis: disaggregation by race/ethnicity and gender
- Longitudinal-can calculate graduation rate

## Variation by Engineering discipline

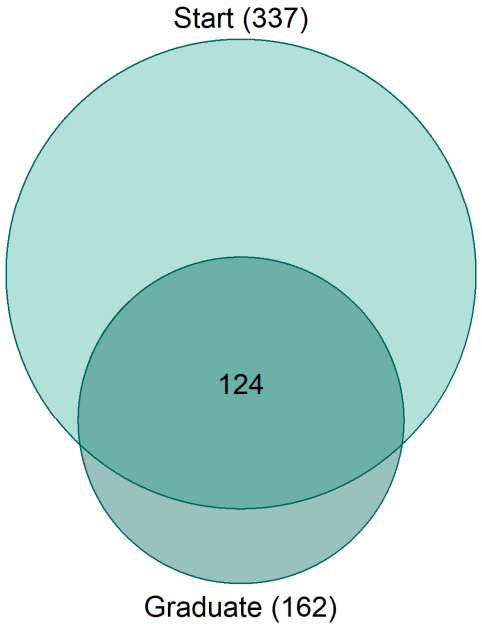
- Electrical (EE) & Mechanical Engineering (ME): highest # students but lowest % women
- Other engineering disciplines: higher % women but smaller # students
- Aggregating all engineering disciplines produces skewed view.
- Engineering Disciplines have their own cultures



## Pipeline



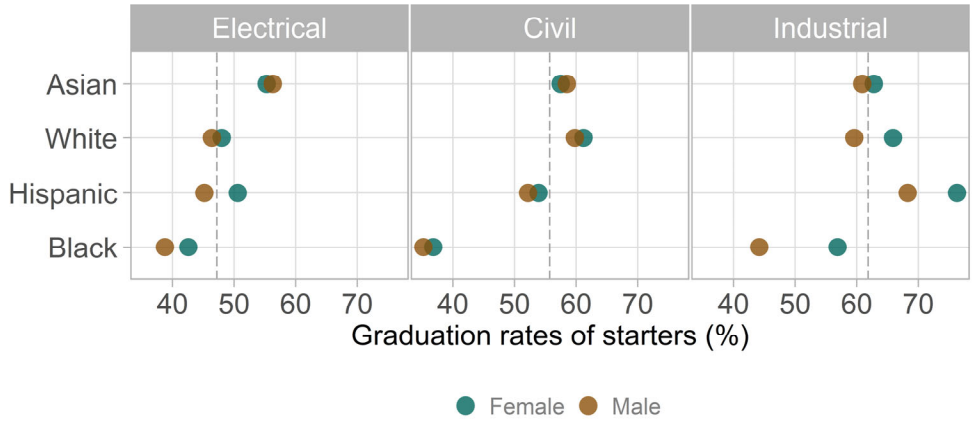
# Pipeline Metric: Graduation Rate



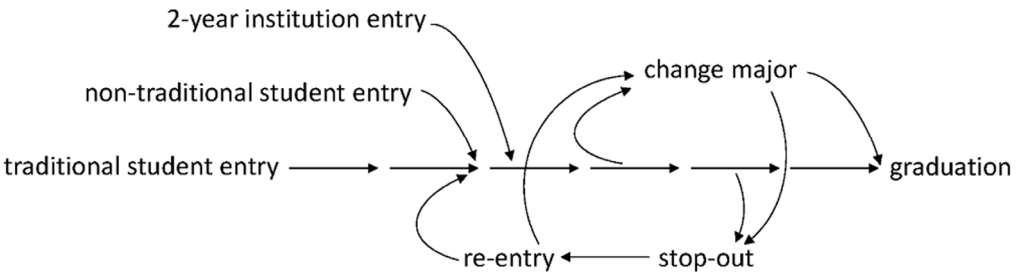

Black Female students in CE
337 start in CE

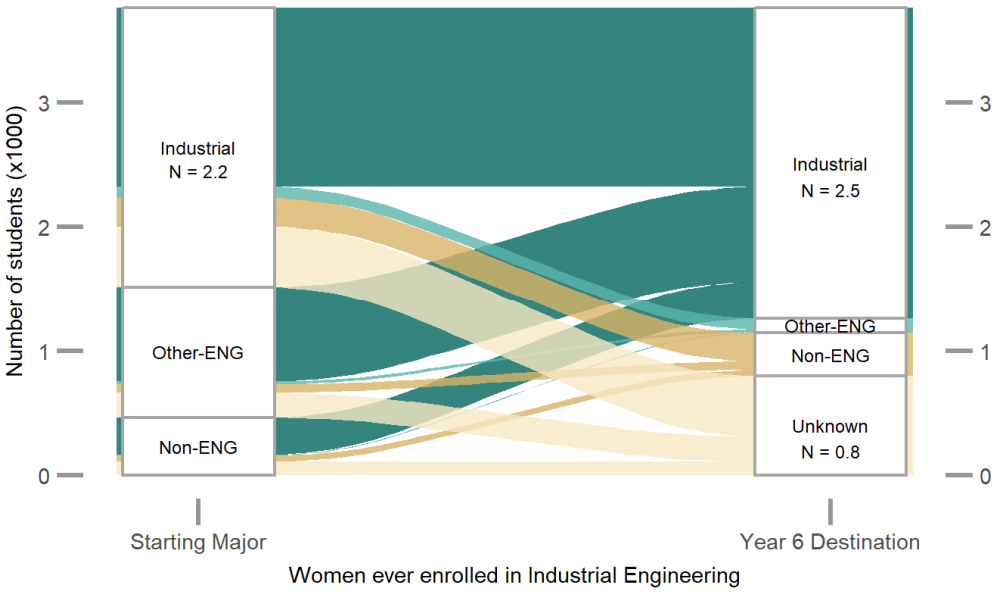
Of those, 124 graduate in CE
Graduation rate = 124 / 337 = 37%

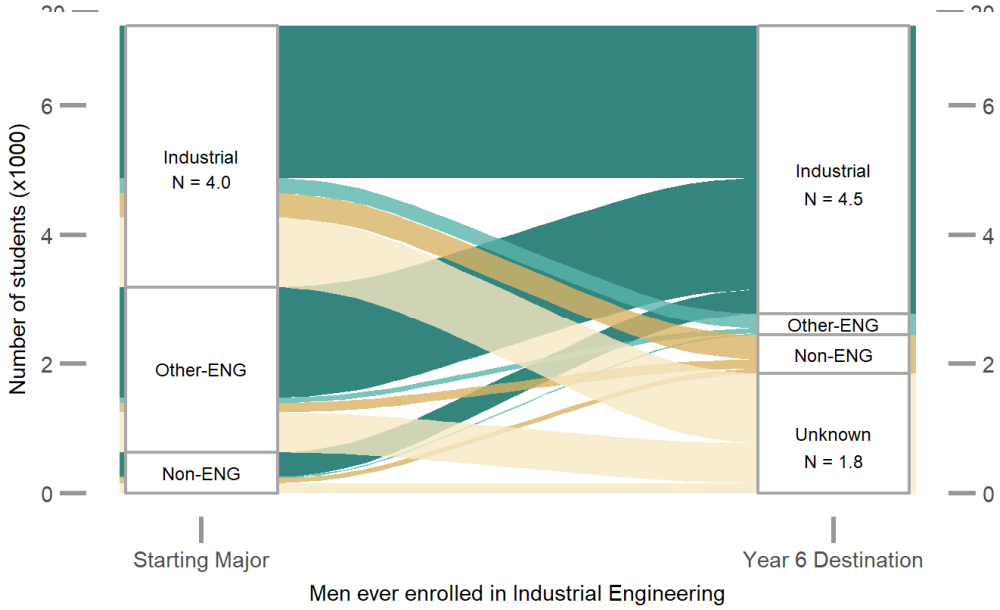
# Engineering Discipline Matters




# Pathways






## Research Question

"How do the trajectories of engineering students in different engineering disciplines vary by race/ethnicity and gender?"



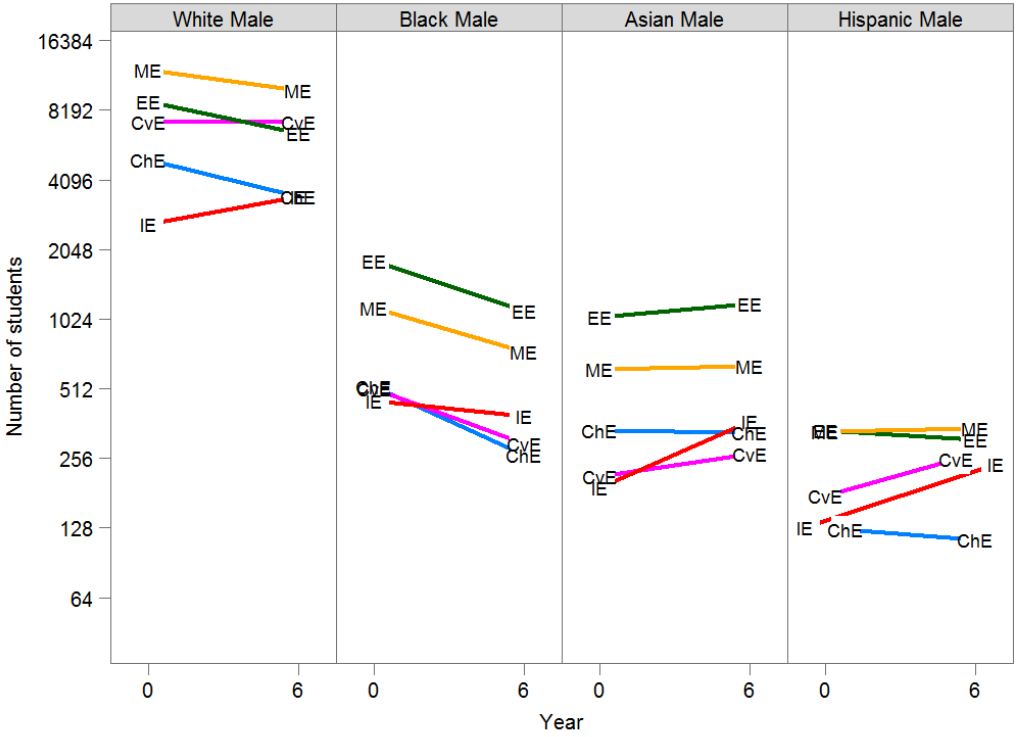
## Research Method

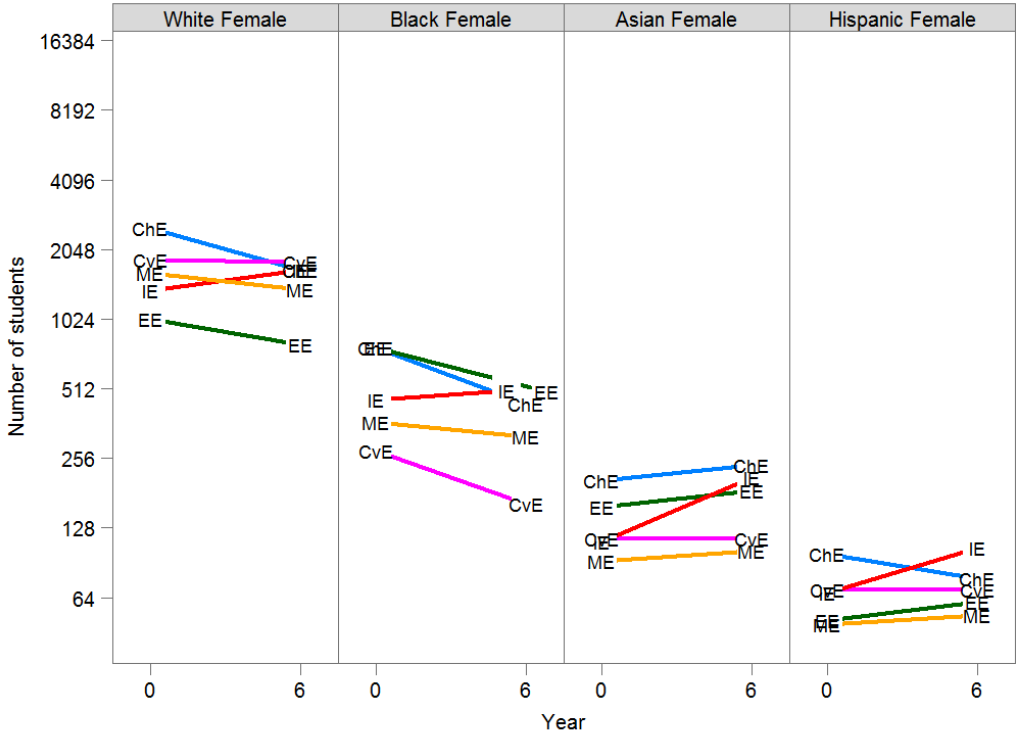
- Focuses on largest engineering disciplines: Chemical (ChE), Civil (CVE), Electrical (EE), Industrial (IE), & Mechanical (ME)
- Trajectories measured at matriculation & 6-year graduation for students who
  - Matriculate directly into engineering discipline (FTIC)
  - Matriculate into a first-year engineering (FYE) program (FTIC)
  - Migrate into engineering (FTIC)
  - Choose engineering as Transfer students
- Race/ethnicity self-reported by students including Asian, Black, Hispanic, and White



## Trajectories

- All engineering disciplines lose about half of their starters.
- When transfer students and others who switch into the majors included, there is variation by race/ethnicity, gender, and engineering discipline.




# Most popular engineering disciplines vary by gender and race/ethnicity

For male engineering students

- Top 2 choices at *start* and graduation: ME and EE
- Whites prefer ME; Blacks & Asians prefer EE; Latinos choose ME and EE at about same #

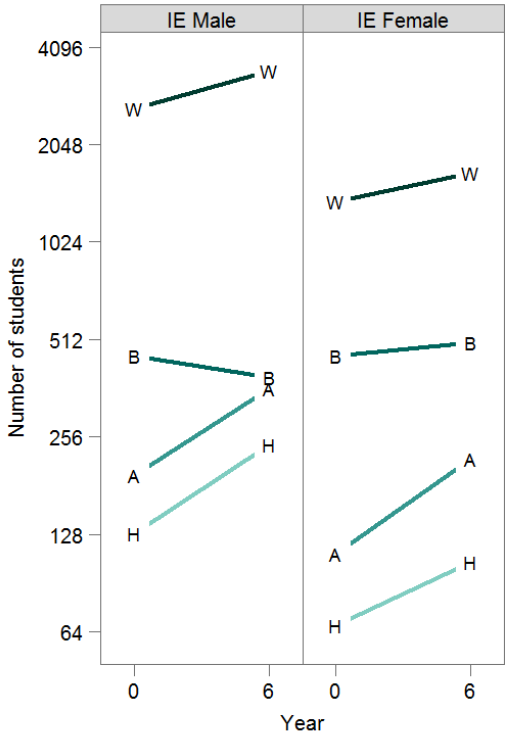
For female engineering students

- ChE more popular than ME
- Latinas prefer ChE & IE at *start*; flip to IE & ChE by graduation
- Whites top 2: ChE and Civil at *start* and graduation
- Black and Asian top choices at *start* ChE and EE
- Graduation top choices: EE & IE for Black and ChE & IE for Asian

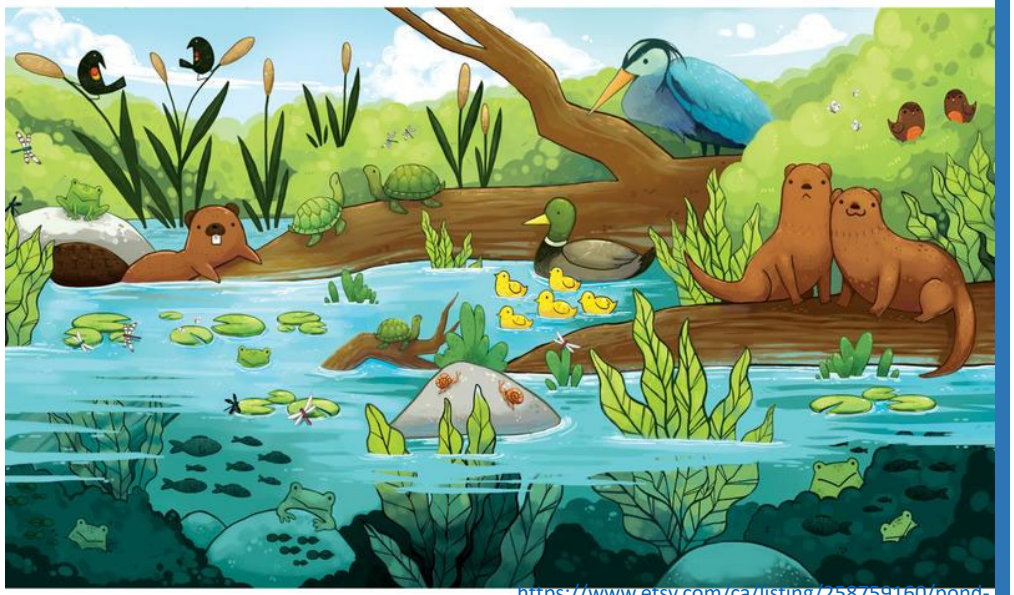


# Industrial Engineering is different!

- Growth for all populations (except Black men) between matriculation and graduation
- IE attracts men and women from all races/ethnicities.
- Lessons to be learned?

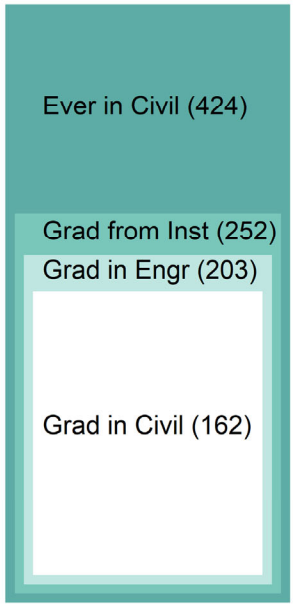


# Ecosystem



https://www.etsy.com/ca/listing/258759160/pond-and-river-ecosystem-print-childrens

# Stickiness



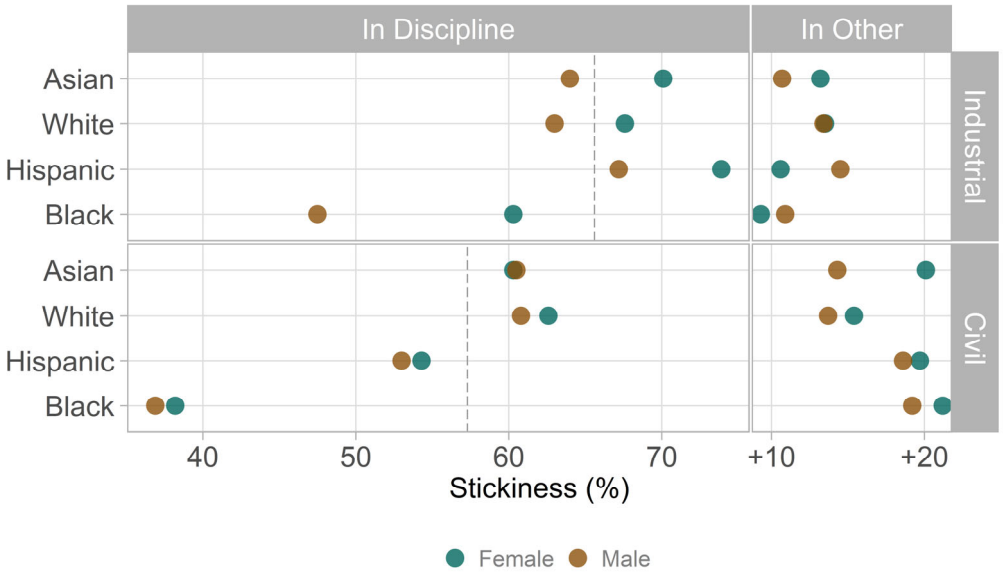

Black Female students in CE
424 ever enrolled in CE

Of those, 252 graduated from the Institution
Institutional stickiness = 252 / 424 = 59%

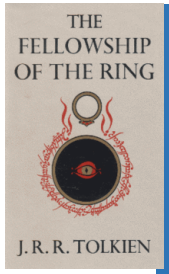
Of those, 203 graduated in an Engr discipline
Engineering stickiness = 203 / 424 = 48%

Of those, 162 graduated in CE
Major stickiness = 162 / 424 = 38%

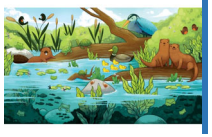
# Stickiness



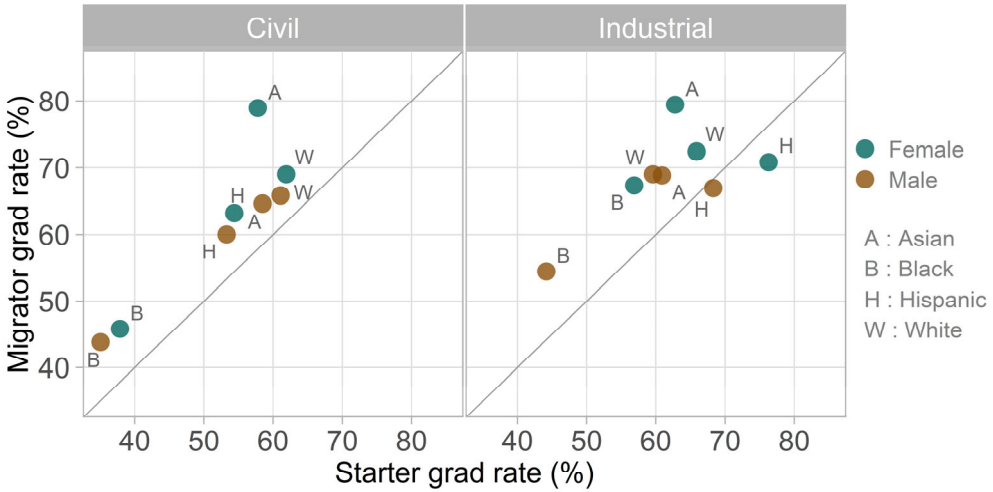

# Migrators

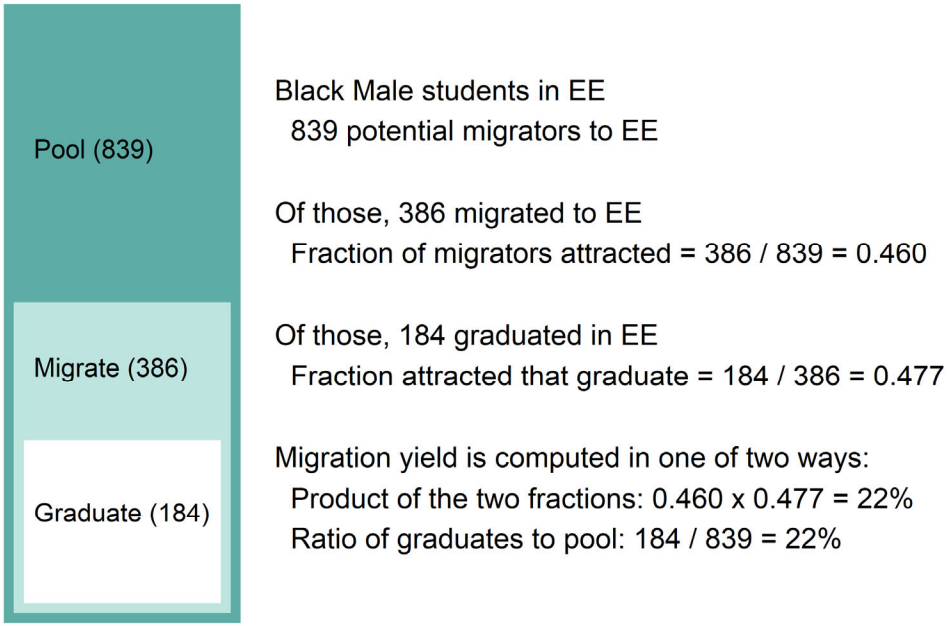



- "Not all those who wander are lost."
- How successful are undergraduate students who migrate into engineering?
- Adopting an ecosystem mindset, we developed metrics to uncover successes of students who migrate among the top five engineering disciplines.



# Migrators are successful!



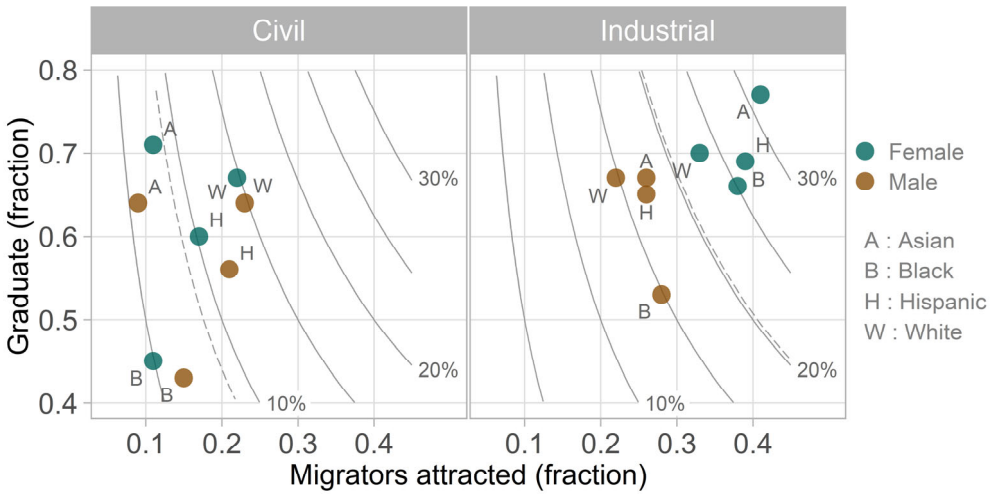

Black Male students in EE
839 potential migrators to EE

Of those, 386 migrated to EE
Fraction of migrators attracted = 386 / 839 = 0.460

Of those, 184 graduated in EE
Fraction attracted that graduate = 184 / 386 = 0.477

Migration yield is computed in one of two ways:
Product of the two fractions: 0.460 x 0.477 = 22%
Ratio of graduates to pool: 184 / 839 = 22%

# Migration Yield




# Summary/Conclusion

- Metaphors influence metrics
- Nuances of engineering education ecosystem
- Migrators have stories of success
- Consider more effective metrics and data displays
- Use an ecosystem mindset to offer new insights