

# TAILORING INTERVENTIONS FOR DEVELOPING ENGINEERING TALENT IN AREAS OF NATIONAL STRATEGIC NEED

WORK IN PROGRESS



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# OUTLINE

- Introduction
- Theoretical Model
- Setting & Profile Development
- Tailored Intervention Plan
- Lessons Learned & Recommendations
- Conclusion



# INTRODUCTION:THE ACCESS PROJECT

***An S-STEM Model to Enhance Engineering Workforce Development in Areas of Local and National Strategic Need through Financial,Academic, and Professional Supports for Talented, Low-Income Students***

***“Advancing Civil, Computer, and Electrical engineering Scholars for Success” (ACCESS)***

- This project integrates elements of theory of change and differentiated instruction
- OBJECTIVE: bolstering upper-level students to persist and complete their degrees while promoting their engagement in NSN areas
- Targets academically talented students in Civil, Computer, and Electrical Engineering with potential for NSN areas
- Intervention Model:
  - A scholarship
  - Professional development activities
  - Faculty and peer mentorship, and
  - Experiential learning opportunities



# PROBLEM ADDRESSED

- Main Challenges:
  - Figuring-out how to use lightweight application data to configure student interventions aligned to a theory of change model while applying differentiated instruction strategies
  - Carrying a data-driven refinement of future recruitment cycles
- This paper presents an analysis of ACCESS applicants' data guided by the questions:
  - What do applicants' data reveal about upper-level engineering students interested in NSN areas?
  - How can lightweight variables be used to construct meaningful student profiles?
  - How might these profiles inform targeted intervention design and strengthen future recruitment cycles?
- Advantages of Lightweight Data
  - Faster analysis
  - Focused information
  - Likelihood of completion



# THEORETICAL MODEL

## ■ Theory of Change Model

- Student progression toward NSN-aligned areas is an outcome of an intentional, evidence-based intervention that reinforces academic momentum, self-efficacy, and professional identity
- The information drawn from a minimal data set becomes an early indicator of student readiness for targeted interventions that influence persistence and degree completion

## ■ Differentiated Learning

- The analysis enables the construction of actionable student profiles that allow for identifying individual levels or readiness, motivation, and interest
- The constructed profiles enable tailored advising, experiential learning placements, and individualized mentoring, ensuring interventions remain appropriate for the targeted need areas



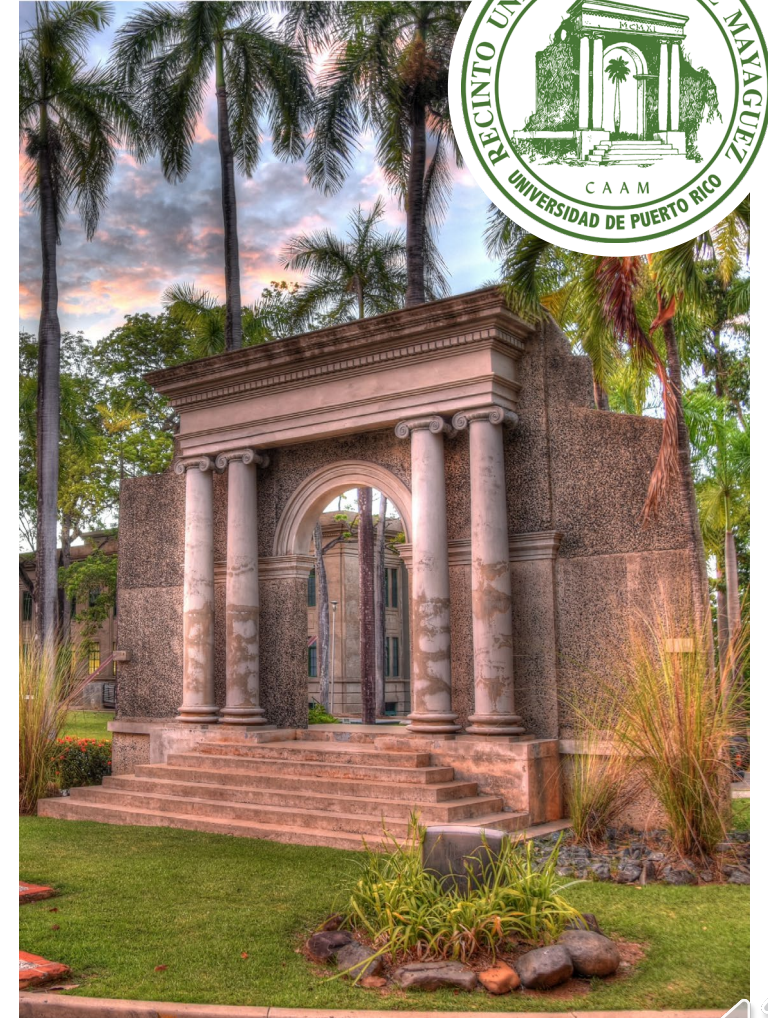
# ACADEMIC SETTING: THE UPRM

## The University of Puerto Rico Mayaguez (UPRM)

- A Hispanic Serving Institution with ~10,616 students
- Part of the 11-campus UPR System
- 99.2% are Hispanic Students
- Colleges: Agriculture, Arts & Sciences, Business, Engineering

## The College of Engineering

- 3<sup>rd</sup> largest provider of US Hispanic engineers (622 in 2024)
- Enrollment: 4,979 students in degree programs (46.9%)
- Degree Programs: Nine (9) 5-year-long BS + 15 Grad (9 MS + 6 Ph.D.)



# TARGET POPULATION

## Applicants' Pool (619)

- Target Programs (Level Eligible / Total Enrollment)
  - Civil Engineering (246 / 573)
  - Computer Engineering (172 / 405)
  - Electrical Engineering (201 / 476)
- Maturity Levels (Level Enrollment)
  - 4<sup>th</sup> Year (216)
  - 5<sup>th</sup> Year (218)
  - 6<sup>th</sup> Year (185)
- A total of 172 students responded phase-I invitation

## S-STEM Criteria

- Economic Need
  - Provided by the Financial Aid Office
- Academic Talent
  - Operationalized in the Project
  - Academic Momentum Indicator
    - Grade-point Average (GPA) – 2.50 or higher
    - Credit Approval – 70% or more for current level

## NSN Interest Areas

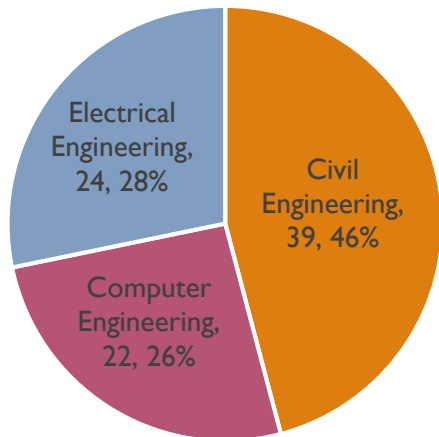
- Student Selected/Provided (Open)
  - 15 Program Defined Areas
  - 18 Student Provided Areas

# DATASET STRUCTURE AND CHARACTERISTICS

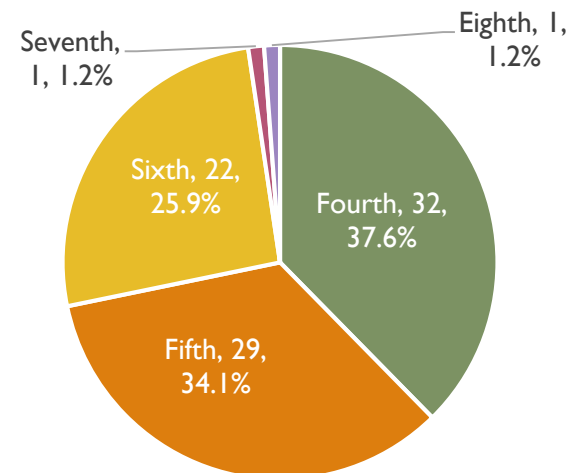
## Collected Data (85 need-qualified respondents)

- Study program
- Year of study
- GPA
- Credit-completion percentage
- Self-reported areas of NSN interest

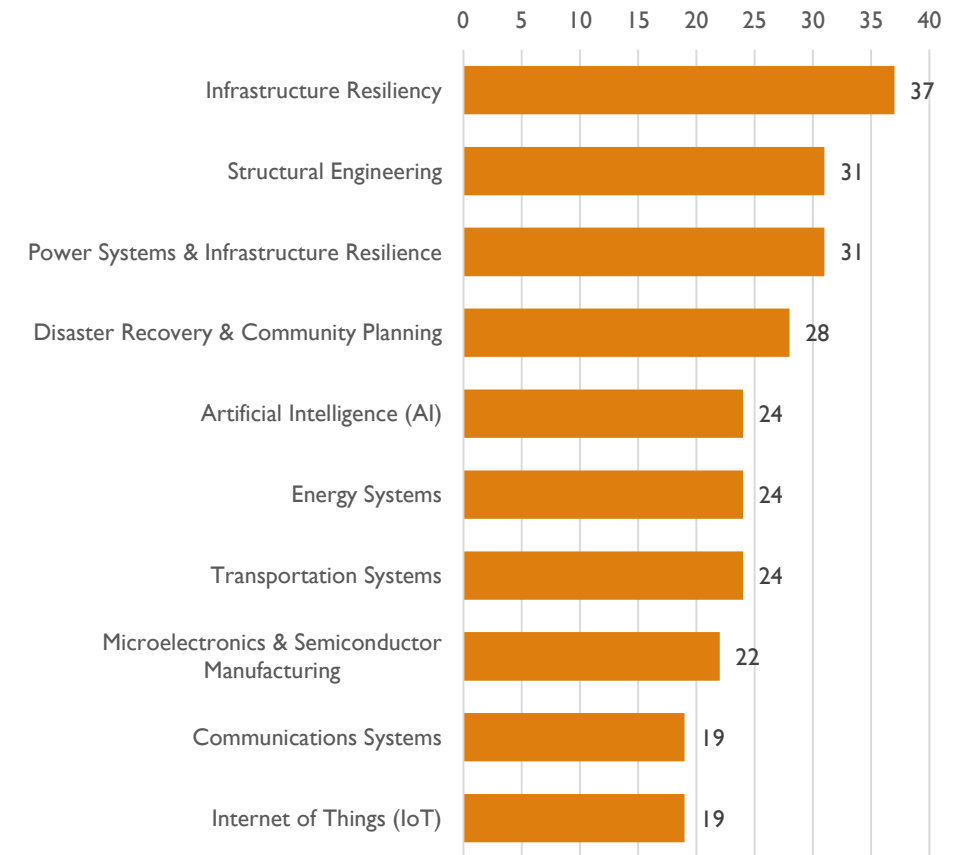
Study Program



Study Year



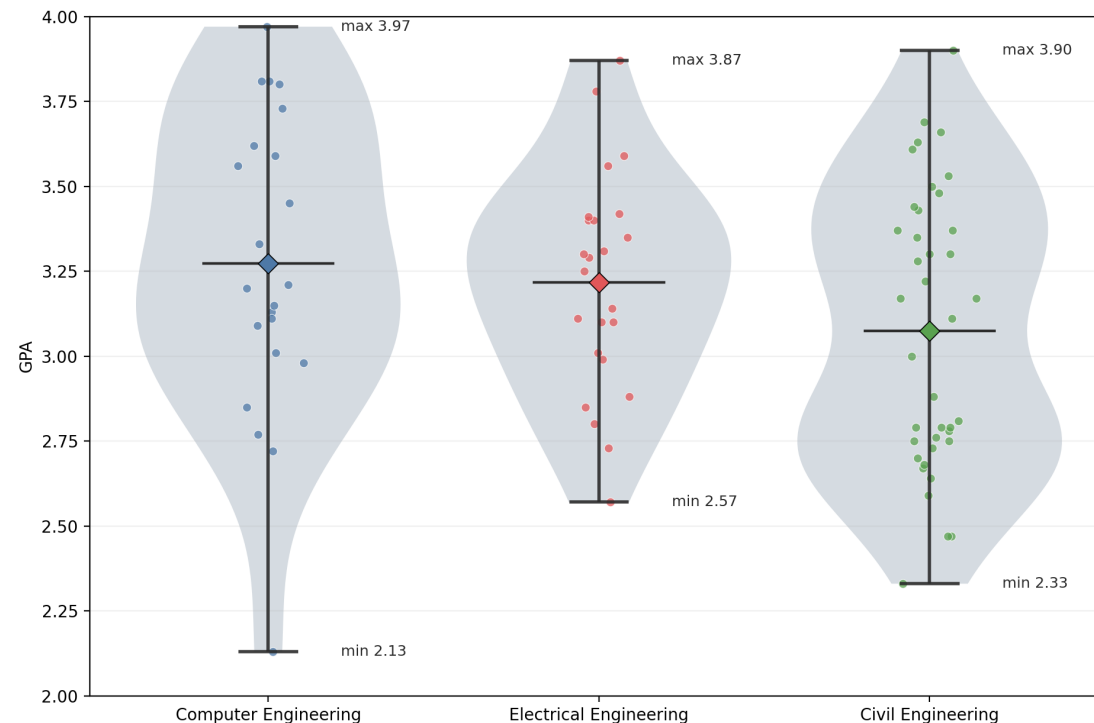
Top-Ten NSN Area Choices



# DATASET STRUCTURE AND CHARACTERISTICS (CONT.)

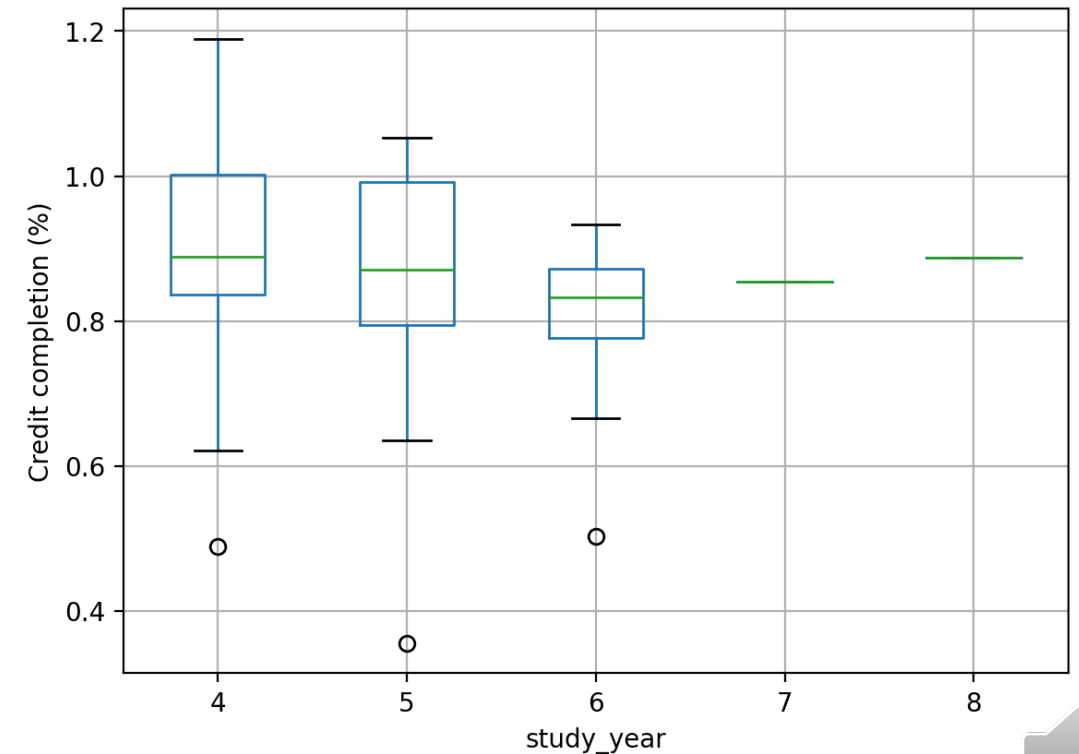
## ■ GPA Distribution by Study Program

- CpE students: highest average and the GPA widest variation
- Excellent overall average GPA:  $M=3.19$ ,  $SD=0.38$



## ■ Credit Completion By Study Year

- Average falls with study years. A few DnQ outliers
- Excellent overall approval rate:  $M=85.6\%$ ,  $SD=14.3\%$



# PROFILE DEVELOPMENT

## Academic Momentum (Talent Criteria)

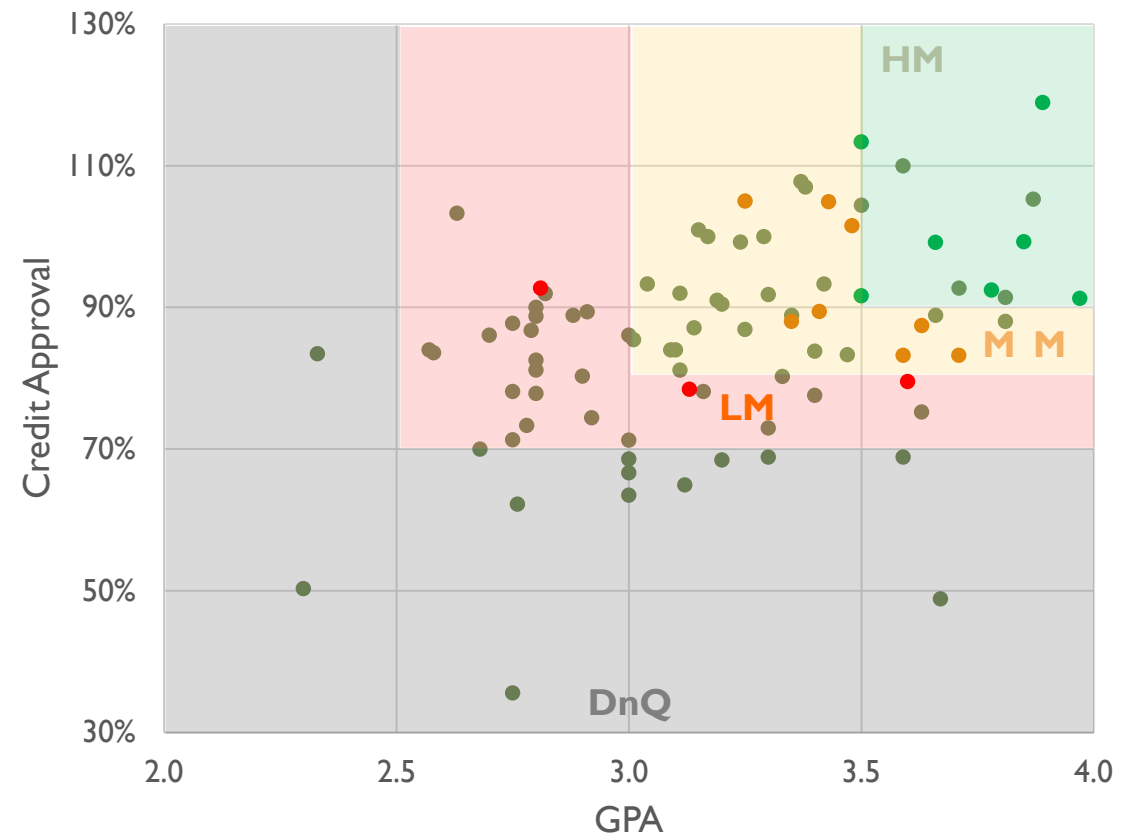
- **DnQ** (Do not Qualify):  
( $GPA < 2.50$  OR  $Cr\% < 70\%$ )
- **Low (LM)**  
( $2.5 \leq GPA < 3.0$ ) OR ( $70\% \leq Cr\% < 80\%$ )
- **Moderate (MM)**  
( $3.0 \leq GPA < 3.5$ ) OR ( $80\% \leq Cr\% < 90\%$ )
- **High (HM)**  
( $GPA \geq 3.5$ ) AND ( $Cr\% \geq 90\%$ )

## NSN Interest Area Alignment

- **Clear:** Interest area well aligned with discipline
- **Exploratory:** Large multiplicity or diffused areas
- **Misaligned:** Interest pointed outside study discipline

## Academic Momentum Zones

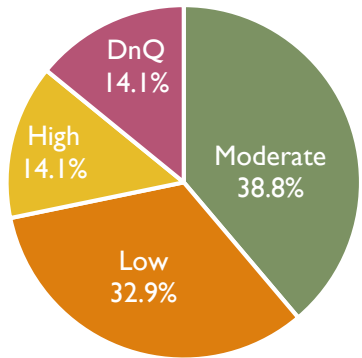
- RYG Colored Dots = Scholars



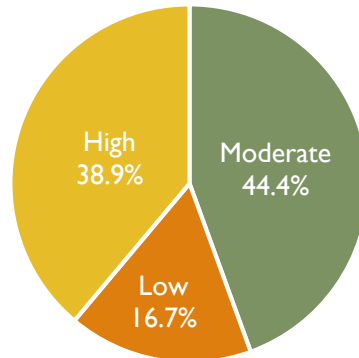
# PROFILING RESULTS

## ■ Academic Momentum

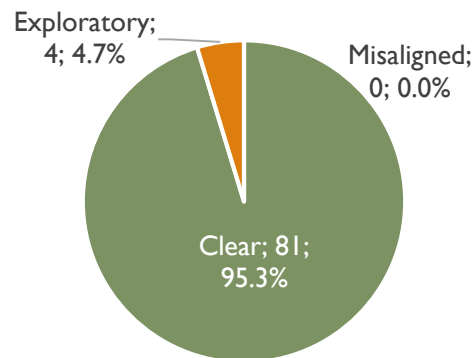
Applicants' Momentum



Scholars' Momentum



## ■ NSN Interest Alignment



## ■ Momentum Profiles

- Broad diversity of eligible applicants (LM,MM,HM)
- 59% of qualified applicants are either Moderate or High

## ■ Interest Alignment

- 95.3% of responses showed a Clear NSN alignment
- Exploratory alignments observed only among Low-momentum applicants
- No misaligned interests denotes a broad resonance of NSN areas among applicants

## ■ Selected Scholars

- Distributed across the entire momentum spectrum
- NSN potential in selection criteria valued high-alignment applicants across all momentum zones
- 17% of Low-momentum scholars highlights the relevance of coherent NSN interest over just GPA and credit approval



# TAILORED INTERVENTION PLAN

Three streams per term based on academic momentum while fostering NSN alignment

**Stream 1:** Formative workshops, invited talks, and NSN-focused seminars

- HM: Career-mapping tied to post-graduation goals
- MM: Apply workshop insights to academic planning and course sequencing
- LM: Persistence-targeted reflections, short-term goals, and academic recovery

**Stream 2:** Experiential Learning opportunities in NSN-aligned areas

- HM: Encouraged to pursue NSN-aligned research, internships, and co-ops
- MM: Balanced co-ops, internships, or mentored research/design challenges for academic stability
- LM: Coaching to strengthen academic momentum. Modular research tasks or scoped special projects.

**Stream 3:** Socio-cognitive Supports

- Scaled faculty/peer mentoring + IDPs based on momentum level
- Single structure, internally differentiated by momentum level

Culminated with and end-of-term event celebrating progress and belonging

# LESSONS LEARNED

- 1 Academic Momentum resulted in a powerful indicator of student readiness
- 2 NSN interest helped differentiating applicants attitudes towards key areas
- 3 Distinct momentum patterns across majors enable discipline-specific supports
- 4 Future recruitment cycles should add items on NSN clarity, motivation, & contextual constraints
- 5 A standardized, profile-based intervention guide will ensure consistent, scalable support across cohorts



# CONCLUSION

A small, minimal dataset can still provide meaningful insight into upper-level engineering students' readiness for NSN-aligned pathways.

Actionable student profiles enabled tailored interventions to boost academic momentum and NSN career alignment.

Early evidence shows this profiling approach improves customized advising and experiential placement

The exercise allowed us identifying refinements for strengthening evaluation metrics in future recruitment cycles

WIP: Ongoing improvements efforts to further support NSN-focused workforce development



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### Areas of Interest:

- Embedded, Cyber-physical Systems
- Automated Electronic Characterization of Devices & Systems
- Rapid Prototyping of Electronics System
- Engineering Education



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