

Board 95: Expanding Access to and Participation in MIDFIELD (Year 3)

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Matthew W. Ohland is Professor of Engineering Education at Purdue University. He has degrees from Swarthmore College, Rensselaer Polytechnic Institute, and the University of Florida. His research on the longitudinal study of engineering students, team assignment, peer evaluation, and active and collaborative teaching methods has been supported by the National Science Foundation and the Sloan Foundation and his team received Best Paper awards from the Journal of Engineering Education in 2008 and 2011 and from the IEEE Transactions on Education in 2011 and 2015. Dr. Ohland is an ABET Program Evaluator for ASEE. He was the 2002–2006 President of Tau Beta Pi and is a Fellow of the ASEE, IEEE, and AAAS.

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Susan M. Lord received a B.S. from Cornell University and the M.S. and Ph.D. from Stanford University. She is currently Professor and Chair of Integrated Engineering at the University of San Diego. Her teaching and research interests include inclusive pedagogies, electronics, optoelectronics, materials science, first year engineering courses, feminist and liberative pedagogies, engineering student persistence, and student autonomy. Her research has been sponsored by the National Science Foundation (NSF). Dr. Lord is a fellow of the ASEE and IEEE and is active in the engineering education community including serving as General Co-Chair of the 2006 Frontiers in Education (FIE) Conference, on the FIE Steering Committee, and as President of the IEEE Education Society for 2009-2010. She is an Associate Editor of the IEEE Transactions on Education. She and her coauthors were awarded the 2011 Wickenden Award for the best paper in the Journal of Engineering Education and the 2011 and 2015 Best Paper Awards for the IEEE Transactions on Education. In Spring 2012, Dr. Lord spent a sabbatical at Southeast University in Nanjing, China teaching and doing research.

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Mr. Russell Andrew Long, Purdue University

Russell Long, M.Ed. was the Director of Project Assessment at the Purdue University School of Engineering Education (retired) and is Managing Director of The Multiple-Institution Database for Investigating Engineering Longitudinal Development (MIDFIELD). He has extensive experience in performance funding, large data set analysis, program review, assessment and student services in higher education. One of his greatest strengths lies in analyzing data related to student learning outcomes and, therefore, to improving institutional effectiveness. His work with MIDFIELD includes research on obstacles students face that interfere with degree completion and, as well, how institutional policies affect degree programs. His group's work on transfer students, grade inflation, and issues faced across gender and ethnicity have

caused institutions to change policies so that they may improve. Awards and publications may be found at <https://engineering.purdue.edu/people/russell.a.long.1>.

Dr. Catherine E. Brawner, Research Triangle Educational Consultants

Catherine E. Brawner is President of Research Triangle Educational Consultants. She received her Ph.D. in Educational Research and Policy Analysis from NC State University in 1996. She also has an MBA from Indiana University (Bloomington) and a bachelor's degree from Duke University. She specializes in evaluation and research in engineering education, computer science education, and technology education. Dr. Brawner is a founding member and former treasurer of Research Triangle Park Evaluators, an American Evaluation Association affiliate organization and is a member of the American Educational Research Association and American Evaluation Association, in addition to ASEE. Dr. Brawner is also an Extension Services Consultant for the National Center for Women in Information Technology (NCWIT) and, in that role, advises computer science and engineering departments on diversifying their undergraduate student population. She remains an active researcher, including studying academic policies, gender and ethnicity issues, transfers, and matriculation models with MIDFIELD as well as student veterans in engineering. Her evaluation work includes evaluating teamwork models, broadening participation initiatives, and S-STEM and LSAMP programs.

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Hossein Ebrahiminejad is a Ph.D. student in Engineering Education at Purdue University. He completed his M.S. in Biomedical Engineering at New Jersey Institute of Technology (NJIT), and his B.S. in Mechanical Engineering in Iran. His research interests include student pathways, educational policy, and quantitative research methods.

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Hassan Al Yagoub is a Ph.D. student in Engineering Education at Purdue University. His research interests include diversity & inclusion, students' persistence, advising and mentoring, engineering career pathways, and school-to-work transition of new engineers. He holds a B.S. in Mechanical Engineering from University of Wisconsin-Milwaukee and a M.S. in Mechanical Engineering from Georgia Institute of Technology. Prior to beginning his doctoral studies, Hassan worked for five years at General Electric where he graduated from their Edison Engineering Development Program (EEDP) and then worked as a gas turbine fleet management engineer. In addition to his technical role, Hassan supported the recruiting, interview, and selection process of the EEDP Program, where he mentored interns, co-ops and Edison associates from the Middle East and Africa regions by developing and teaching a technical training curriculum, providing guidance for graduate school applications, and providing career consultation.

Expanding Access to and Participation in MIDFIELD (Year 3)

Executive Summary

This project seeks to expand the number of institutions participating in the Multiple-Institution Database for Investigating Longitudinal Development (MIDFIELD).

Background on MIDFIELD

MIDFIELD is a resource enabling the study of students that includes longitudinal, whole population data for multiple institutions. More details about the dataset are available in [1]. MIDFIELD has been used in high impact research on student trajectories in engineering education. This work has helped to change the conversation in engineering education, by demonstrating that the appearance of a particularly high rate of attrition is actually the result of a higher-than-typical retention rate, but a replacement rate that is much lower than other disciplines [2]. MIDFIELD results have shown that women are as likely as men to persist in engineering, that women follow similar pathways to men if they leave engineering, [3] and that student demographics and outcomes vary by engineering discipline, gender, and race [4, 5, 6, 7, 8, 9, 10, 11]. Research with MIDFIELD has also shown that the way persistence is measured can result in a “systematic majority measurement bias” [12] and revealed that students who migrate into engineering disciplines are successful [13]. This research has led to new metrics such as “stickiness” [14] and migration yield [15]. MIDFIELD studies using a proxy for socioeconomic status (SES) revealed that race/ethnicity was no longer a predictor of success when SES was considered [16]. Recently, MIDFIELD data was used to compare pipeline, pathways, and ecosystems metaphors for studying student persistence [15]. MIDFIELD data includes sufficient depth to explore metrics inspired by each metaphor for different disciplines of engineering. The value of MIDFIELD research to the engineering education research community has been recognized with many invited talks, four best paper awards [2, 6, 7, 12] and the 2013 Women in Engineering Proactive Network (WEPAN) Betty Vetter Award for Research "for exceptional research committed to understanding the intersectionality of race and gender" [17].

Expanding Participation

Although MIDFIELD has been used in high impact research using the student as the unit of analysis, its value as a predictive tool has been limited due to the small (eleven) number of institutions included. The expansion funded by this current NSF grant enables studies using the institution as the level of analysis. This moves MIDFIELD toward being a national, longitudinal student unit-record database that enables study of engineering programs and benchmark metrics consistently. This will make it possible to compare the outcomes of institutional policies while controlling for other variables such as selectivity, institutional control, endowment spending per student, and more.

This project aims to expand MIDFIELD database from 11 to 103 institutions containing over 10 million students. More specifically the data will represent over 50% of the U.S. engineering undergraduate degrees awarded and increase the diversity of institutions in the dataset. MIDFIELD will include public and private institutions, minority-serving institutions, and institutions from a broad range of research classifications. The sheer scope and longitude of MIDFIELD will enable significant improvements in research in higher education. It will enable the development of research capacity to examine student characteristics (race/ethnicity/sex/social

class) and curricular pathways (including coursework) by institution and over time. Because the dataset contains students records of all students matriculating over a period of time, researchers can study students across all disciplines, not just engineering. Due to the broad nature of the disciplines represented by MIDFIELD, this project has cross-Directorate support from the Directorates of Engineering, Math and Physical Sciences (MPS), and Education and Human Resources (EHR) as well as the Office of Integrative Activities (OIA). Within the MPS Directorate, this work is supported by Astronomy, and Physics; within EHR, this work is supported by the EHR Core Research (ECR) program.

This project is designed to recruit a stratified sample of US institutions with engineering programs. In targeting institutions to join MIDFIELD, we aim to reflect variability in geographic region, institution size as determined by the number of engineering graduates per year, and institutional control (public or private). Minority-serving institutions (MSIs) are also targeted with plans to include adding five additional Historically Black Colleges and Universities (HBCUs), seven Hispanic Serving Institutions (HSIs), five institutions with high Native American populations, and seven universities with high Asian/Pacific Islander populations. . MIDFIELD partners have the opportunity to conduct peer comparisons, carry out research to inform local policies and practice, and receive unblinded information about their institution.

As of December 2018, we have secured participation agreements from 27 institutions in addition to the original 11, bringing the total number of institutions in MIDFIELD to 38. MIDFIELD now includes 2,127,195 students from 1988 to the present with 348,602 being engineering students. Thirty-one (31) other institutions are in the process of signing memoranda of understanding (MOU) agreements. The current status of negotiations with partner institutions is shown in Table 1 and illustrated in Figure 1.

Table 1. Status of negotiations with proposed MIDFIELD partner institutions as of December 2018.

Institution (city)	Status
Arizona State University (Tempe)	Commitment letter received
Baylor University (Waco)	Faculty champion
Boise State University (Boise)	Faculty champion
Bucknell University (Lewisburg)	Faculty champion
California Polytechnic State University-San Luis Obispo (San Luis Obispo)	Commitment letter received
California State University - Los Angeles (Los Angeles)	Faculty champion
Campbell University (Buies Creek)	MOU signed
Clemson University (Clemson)	Data received
Colorado School of Mines (Golden)	Faculty champion
Colorado State University (Fort Collins)	Data received
East Carolina University (Greenville)	Data received
Elizabethtown College (Elizabethtown)	Data received
Embry-Riddle Aeronautical University - Daytona Beach (Daytona Beach)	Data received

Embry-Riddle Aeronautical University - Prescott (Prescott, AZ)	Data received
Embry-Riddle Aeronautical University - Worldwide Online	Data received
Florida A&M University (United States of America)	Data received
Florida Institute of Technology-Melbourne (Melbourne)	Faculty champion
Florida International University (Miami)	MOU signed
Florida State University (Tallahassee)	Data received
Georgia Institute of Technology - Main Campus (Atlanta)	Data received
Harding University (Searcy)	Faculty champion
Iowa State University (Ames)	Faculty champion
Kennesaw State University (Kennesaw)	Commitment letter received
Louisiana Tech University (Ruston)	Commitment letter received
Michigan State University (East Lansing)	Faculty champion
Michigan Technological University (Houghton)	Faculty champion
Minnesota State University - Mankato	Faculty champion
Mississippi State University (Mississippi State)	Faculty champion
North Carolina A & T State University (Greensboro)	Data received
North Carolina State University (Raleigh)	Data received
Ohio State University (Columbus)	Commitment letter received
Pennsylvania State University (University Park)	Faculty champion
Prairie View A & M University (Prairie View)	Faculty champion
Purdue Statewide Technology (United States of America)	Data received
Purdue University (West Lafayette)	Data received
Purdue University Northwest (Hammond)	Data received
Rice University (Houston)	Faculty champion
Rose-Hulman Institute of Technology (Terre Haute)	Commitment letter received
Rowan University (Glassboro)	Faculty champion
Rutgers, The State University of New Jersey (New Brunswick)	Commitment letter received
San Jose State University (San Jose)	Commitment letter received
South Dakota School of Mines and Technology (Rapid City)	Data received
Southern Polytechnic State University (Marietta)	Commitment letter received
Texas A&M University (College Station)	Faculty champion
Texas State University (San Marcos)	Faculty champion
Texas Tech University (Lubbock)	Faculty champion
The University of Texas at El Paso (El Paso)	Faculty champion
Tufts University (Boston, MA)	Faculty champion
Tuskegee University (Tuskegee)	Faculty champion

University of Arkansas, Fayetteville (Fayetteville)	Commitment letter received
University of Arkansas at Little Rock (Little Rock)	Faculty champion
University of California - Irvine (Irvine)	Commitment letter received
University of California - Merced	Faculty champion
University of Colorado at Boulder (Boulder)	Data received
University of Florida (Gainesville)	Data received
University of Houston - Downtown (Houston)	Faculty champion
University of Louisville (Louisville)	MOU signed
University of Maryland - Baltimore County (Baltimore)	Commitment letter received
University of Massachusetts Amherst (Amherst)	Faculty champion
University of Michigan - Ann Arbor (Ann Arbor)	Faculty champion
University of Nevada - Reno (Reno)	MOU signed
University of North Carolina at Charlotte (Charlotte)	Data received
University of Notre Dame (Notre Dame)	Faculty champion
University of Oklahoma (Norman)	Data received
University of Pittsburgh - Main Campus (Pittsburgh)	Faculty champion
University of Puerto Rico at Mayaguez	Commitment letter received
University of San Diego	Faculty champion
University of South Florida (Tampa)	Commitment letter received
University of Virginia (Charlottesville)	Faculty champion
Utah State University (Logan)	Data received
Valparaiso University (Valparaiso)	MOU signed
Virginia Polytechnic Institute and State University (Blacksburg)	Data received
Western Kentucky University (Bowling Green)	Commitment letter received
Wichita State University (Wichita)	Commitment letter received
Youngstown State University (Youngstown)	Faculty champion

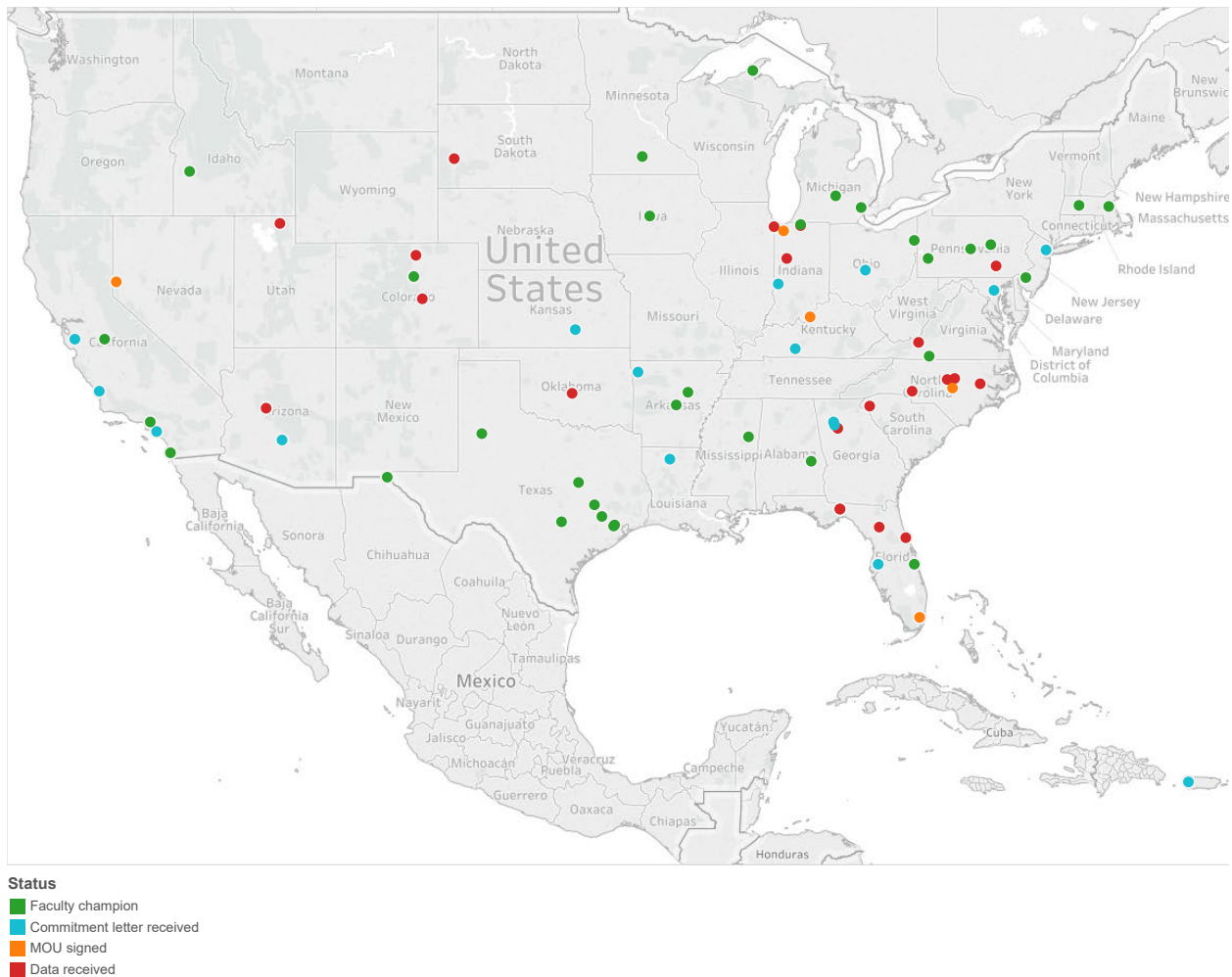


Figure 1 MIDFIELD Partner Institutions Map available at https://public.tableau.com/shared/SBY5ZPS6D?:display_count=yes

Documentation of Institutional Policies

In addition to collecting student record information, we are compiling academic policy information for each partner institution. This involves collecting and coding catalogs from each of the partner institutions during the time period of the data collected. A team of undergraduate students has been trained in human subjects' research protection and the use of NVivo software. For each partner institution and for each year they have contributed data to the MIDFIELD database, the student research team is coding the university catalogs in the following areas:

- Admissions policies for engineering students – including high school GPA, standardized test scores, transfer admissions, preferential admissions (e.g., highly qualified, sociodemographic characteristics, or of a particular faith), awareness of financial need, and policies regarding admission of international students.
- Academic progress policies for engineering students - GPA and course requirements for maintaining satisfactory progress towards a degree, and required coursework for engineering; also measures of unsatisfactory progress, including warning, probation, suspension, and expulsion and performance needed to return to good academic standing.

- Engineering matriculation model – admission to a first-year engineering program, admission to an engineering major, admission to engineering for less qualified students, enrollment management (e.g., minimum GPA) in force for any major.
- Financial aid - for highly qualified state residents (e.g., HOPE), “loan free” aid policies, or for members of sociodemographic groups, standards for retaining aid.
- Grading policies – grading scale, handling of incomplete grades, course repeat, forgiveness, withdrawals.
- Disability policies, including services provided and requirements to access services.

The policies for each school have been summarized and both the summaries and the complete codebook are available on the MIDFIELD website. The NVivo project files can be made available to researchers who wish to include institutional context with their study of MIDFIELD variables and outcomes.

The policy research team won all three undergraduate research awards at the 5th Annual Dawn or Doom Conference held at Purdue University in November 2018 for their papers on disability policies (1st place) [18], required core engineering courses over time (2nd place) [19], and standards for academic policies over time (3rd place) [20]. The latter two of these papers were also presented at the Purdue Undergraduate Research Symposium. A poster on trends in engineering education policies showed how policies have changed over time at MIDFIELD institutions and was presented at the ASEE IL-IN conference [21]. A study of undergraduate course pathways and the influence on students’ academic success is in progress [22].

Expanding the Network of Researchers

Another important goal of this project is to help a wider research community learn about MIDFIELD, gain access to it, and conduct research using the dataset. In line with this goal, we have held workshops at engineering education conferences including Frontiers in Education (FIE) and the American Society for Engineering Education (ASEE) Annual Meeting [23, 24, 25]. We also reached out to researchers beyond engineering education at the 2018 American Sociological Association (ASA) annual conference [26].

To provide a firsthand experience with MIDFIELD data, we have created the *midfielddata* practice data set—a stratified sample of data from the MIDFIELD project, comprising student records for 97,640 undergraduate students from 1987 to 2016. This data set is freely available to the public as an R data package on GitHub [27]. Tools for accessing and analyzing these data are provided by the *midfieldr* package, also available via GitHub [28]. Using the functions in *midfieldr*, one can select programs to study, group and summarize by race/ethnicity, sex, and program, and compute and graph various persistence metrics.

We use the R software environment because it is free, open source, available on every major platform, and provides superior tools for contemporary data graphics [29]. We introduced these packages to the R community in 2018 [30] and to the engineering education community in a workshop at the 2018 FIE Conference. The workshop was well attended and the participants were enthusiastic [31].

Acknowledgments

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