New Orleans JAZZED about Engineering Education

Paper ID #16148

Engineering Achievement: An Exploratory Case Study of Minority Engineering Organization Chapter Activities

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Engineering achievement:

An exploratory case study of minority engineering organization chapter activities

Abstract

Studies such as Omer, Sampson & Lee[31] highlight the importance of minority-focused engineering organizations to the achievement of minority students. With over 250 collegiate chapters and nearly 12,000 domestic collegiate members, the National Society of Black Engineers (NSBE) provides a programmatic infrastructure for academic support of students pursuing engineering degrees. However, chapters conduct a wide range of activities that tend to be highly individualized. Thus, the organization seeks to understand how these chapters contribute to the success of each member.

In partnership with the Evaluation and Action Research Associates, NSBE executed an original research study to focus on chapter activities in the collegiate demographic. Participants in this study, which utilized surveys and existing NSBE data, included student chapter leaders as well as advisors (minority engineering program directors, engineering college faculty). Four major questions guided the survey design:

1. What are the characteristics of each chapter?
2. What activities do the chapters engage in, by type?
3. What assessment methods do the chapters employ to track success?
4. What outcomes are the chapters achieving, by type?

The outcomes of interest directly align with NSBE's 2025 strategic goal to graduate 10,000 black engineers annually and include GPA, engineering program retention, graduation rate, and graduate school entrance rates. Ultimately, the analysis paints a more comprehensive picture of who the chapters are and what they do. Many other engineering organizations utilize the chapter model; this research provides an exploratory framework for chapter activities and offers suggestions for better tracking and measuring the key factors that influence success on the collegiate level.

Introduction

Engineering has one of the fastest-growing job markets in the US. However, the labor force struggles to meet this need largely because minorities are not achieving parity in technical fields. In 2014, African Americans made up 13.2% of the total US population[37] but only held 5.2% of the engineering jobs[6]. This discrepancy stems from several systemic factors but becomes most apparent in college engineering enrollment and graduation rates[7]; thus, the dearth of underrepresented minority (URM) students graduating with engineering degrees presents a significant issue to the economy that will struggle with lack of talent to fill jobs in the growing engineering sector. Researchers have identified several interventions that can help bolster the academic achievement of URMs in engineering, and many of these practices are used by minority-focused engineering organizations (MEOs). The forthcoming study provides a realistic view of how MEOs operate at the most fundamental level and supports what existing research says about how MEOs contribute to the retention and achievement of URM students in engineering.

What is a minority-focused engineering organization?

For the purposes of this examination, a minority-focused engineering organization (MEO) is defined as a member association that supports a particular segment of individuals who are underrepresented in engineering (this paper uses "minority" and "URM" interchangeably when describing student populations). Major MEOs include the Society of Women Engineers (SWE), the Society of Hispanic Professional Engineers (SHPE), the American Indian Science and Engineering Society (AISES), and the National Society of Black Engineers (NSBE). Programs and benefits that MEOs offer their members are designed to provide a holistic approach to the challenge of retaining minority students in engineering throughout college. Some literature fits MEOs in with professional engineering organizations[31] whereas others classify them as extracurricular or cocurricular activities[39]. Regardless of classification, there is clear evidence that MEOs support the achievement of minority students pursuing technical majors.

How MEOs contribute to the success of URMs in engineering and other technical majors

Success for undergraduates in engineering culminates in the completion of the bachelor's degree. To arrive at that point, minority students must overcome the many structural, institutional, and pecuniary challenges that so often deter their peers. Although there are many critical points in an academic career at which minority students are discouraged from becoming engineers, most of the research has focused on retention in college, since the attrition rate of minority students is much higher than that of their white counterparts[11]. In 2010, African Americans comprised 5.9% of students enrolled in engineering programs[16] and in 2014 held only 3.5% of the total number of engineering bachelor's degrees[40], suggesting that collegiate retention is crucial.

In "Designing for Success," the Institute for Broadening Participation outlines 12 positive factors that influence student persistence (and, thereby, retention) in engineering[19]. Several of these items factor in before a student's admission to college (i.e., adequate preparation for collegiate STEM courses, afterschool/summer learning opportunities in K—12), occur in the classroom (campus and classroom culture and climate), or are related to students' individual learning characteristics (engagement with the material, active learning, resiliency); after removing those, the resulting list consists of extracurricular factors present in college that can positively affect student retention in engineering majors. Each of those external factors—role models, mentors and mentoring, community support, professional development opportunities, and financial aid[19]—has strong empirical support and helps illuminate why MEOs are effective in a minority student's academic career.

Role models: Several studies have directly highlighted the usefulness of minority-focused engineering organizations in providing role models to URMs[10]; however, role models are as important in the classroom and workplace as they are elsewhere. Because women and minorities are underrepresented in engineering and other STEM fields, it is unsurprising that many have a difficult time seeing themselves pursuing careers in those fields[1]. In college, it is crucial for STEM students to interact with others who look like them; the presence of role models enables URM students to imagine themselves as engineers and, thus, persist in their academic pursuits[38]. Other engineering education advocates have emphasized the importance of "helping students connect their personal identities to engineering identities"[22], and seeing similar others in their major addresses this need. Many researchers have called for stakeholders to focus more on retaining minorities in engineering education so URM engineering students will have more role models within their departments[20].

Mentors and mentoring: Mentoring often allows students to interact with peers or role models who look like them and provide the added benefit of direct assistance with academics, professional development, and/or personal development. Retention programs often include mentoring because of the positive effect it has on students' experience of engineering[30]. Although faculty-student relationships do factor into student persistence[8], mentors are similarly effective if they are individuals outside of the academic department. In a program at Florida International University, mentees accompanied their mentors to work for a day so they could experience an engineering job firsthand[4]. The students who participated in the FIU mentorship program gained valuable insight into engineering as a profession, encouraging them to persist in engineering. Even graduate students benefit from mentoring, demonstrating its value at every stage in a student's career[21]. Most of the major MEOs offer mentorship programs to members at different stages in their academic and professional careers[3, 27, 35].

Community support: By their very nature, MEOs create community among their members. The importance of community support is so pronounced that universities work to group students in their own programs. One of the major tenets of summer bridge programs (summer sessions designed to give newly admitted freshmen, particularly URMs, a leg up in engineering) is clustering, or keeping the students who enter the program together in classes, dormitories, etc. as much as possible[30]. This creates a community of support that follows the student throughout college. In fact, URM students who participated in integrated curricula programs that foster community at institutions such as Texas A&M University and Rose-Hulman Institute of Technology were retained at higher rates than URM students who did not participate[14]. As an intervention strategy, creating communities that present minority students with "opportunities to belong will provide the most return on investment for engagement in academic endeavors,"[2]. Minority students attending historically black colleges and universities (HBCUs) tend to graduate with engineering degrees at higher rates than minority students at predominantly white institutions[23], which suggests that the stronger sense of belonging is associated with higher retention rates. Furthermore, African American students at HBCUs have higher grade point averages and more favorable perceptions of campus climate that other students[5].

Professional development opportunities: Reichert & Absher acknowledge the role an MEO can play in providing professional development to minority students in that it "exists to promote the academic and professional growth of its members,"[32]. Indeed, the major MEOs offer professional development programming at their events and conferences, as well as at the chapter level. Whereas minority engineering organizations significantly support professional development outside the classroom, some engineering programs include professional development as part of their integrated curricula. In the right setting, practical professional engineering skills can be taught to students[33], giving them an advantage in the workforce. By creating a more holistic experience of engineering education, professional development supports greater engagement[9], particularly for minority students who may not have had much interaction with workers in their desired career. Professional development of both students and faculty is crucial for the continuing success of the student[13].

Financial aid: Twenty years ago, financial difficulties were cited as the motivation for up to 30 percent of minority students to drop out of college, regardless of their academic performance [17]. Today, the link between dropping out and struggling to repay loans persists; nearly 40% of African American borrowers drop out of college[18]. Thus, supporting students with scholarship monies is crucial to their success in college. The United Negro College Fund (UNCF) states that

every $5,000 scholarship awarded increases a URM student's chances of graduating by a staggering 7 percentage points[36]. Several authors have noted that students who receive more financial aid have to put in fewer work hours to support themselves[24, 25, 26] and thus, have more time to engage in their studies. A statistically significant relationship between scholarship dollars and graduation rates shows that institutions that offer more financial support to URM students award more engineering degrees than do institutions with less financial support[15]. The Society of Women Engineers reports distributing scholarships totaling over $660,000 in 2015[34] and the National Society of Black Engineers provides scholarships ranging in value from $500 to $10,500[28].

What is the foundation of an MEO?

Most MEOs operate within chapters that convene on university campuses. However, little research has aimed to holistically describe the background, operations, and effects the chapters have on their members. Several studies have shown that MEOs are important, as they encapsulate the success factors previously discussed[10, 20, 32], but few, if any, have directly inquired about those types of activities with markers of success for URM students (retention, GPA, graduation rate). The present descriptive case study focused on the activities of collegiate chapters within the National Society of Black Engineers (NSBE), a non-profit, student-governed organization that aims to support black engineers throughout their academic and professional careers.

The National Society of Black Engineers (NSBE) was founded in 1975 with a mission "to increase the number of culturally responsible Black engineers who excel academically, succeed professionally, and positively impact the community"[29]. Recently, NSBE announced a strategic goal to graduate 10,000 black engineers with bachelor's degrees annually by 2025, up from 3,501 in 2014[40]; for the society to reach this goal, crucial work must be done at the chapter level. With over 200 active collegiate chapters, NSBE has a clear reach that extends to diverse campuses across the nation. The chapter model allows students to participate in programming on the local level and additionally offers leadership opportunities, as each chapter is governed by an elected student executive board. With this number of unique collegiate chapters, the activities each chapter hosts throughout the year becomes highly individualized as well, since what works for one group of students in one location may not work for another[12]. The general goal for this study was to determine what types of activities the chapters perform and how well members are performing, measured by indicators of student success (GPA, retention, and graduation rate). Four major questions guided this study:

1. What are the characteristics of each chapter?
2. What activities do the chapters engage in, by type?
3. What assessment methods do the chapters employ to track success?
4. What outcomes are the chapters achieving, by type?

The first three questions were designed to paint a holistic picture of the chapters—who they are and what they do—whereas the final question seeks to understand the impact the chapters have on their members.

Methods

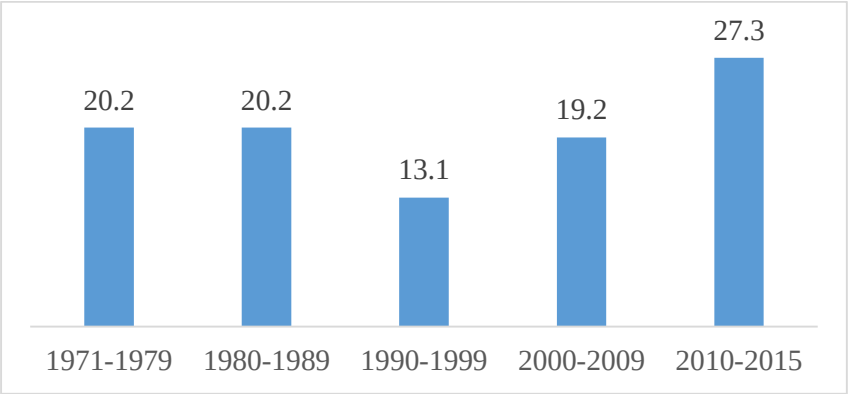
Researchers created two surveys (one for the student chapter officers and one for the chapter advisors) that were disseminated to 203 domestic student chapter officers and 113 chapter advisors via email. Fifty-eight and 70% of officers and advisors, respectively, responded; 98 officers and 60 advisors provided complete, usable data on their chapters. Data collection began in early December and concluded in mid-January. The survey began with questions about the chapter's background (year established, number of paid members, annual budget, etc.) and continued with inquiries into chapter activities and aggregate member outcomes. Participants provided details on a myriad of chapter activities, ranging from tutoring and study groups to outreach and community service. In addition to fixed-answer responses, the survey contained open-ended questions that allowed participants to provide anecdotal evidence relevant to their respective chapters. In several instances, these comments were content-analyzed to extract common themes. Using GPA as a measure, analysis (t tests) determined that the sample size is representative of the population (mean GPA of chapter provided by advisor compared to self-reported GPAs of all collegiate NSBE members, $p >> 0.05$).

Results

Chapter characteristics (study question 1)

The chapter officers were asked to identify the year the chapter was initiated. The officer responses were grouped by decade beginning from the 1970s to the 2010s. Overall, 99 chapter officers were able to identify a specific start year. This information is displayed in Figure 1.

Figure 1: Chapter initiation years



Of the respondents, twenty chapters (20.2%) were initiated in the 1970s and 1980s. Thirteen (13.1%) of the chapters were initiated in the 1990s. An increase was observed in the 2000s where 19 chapters (19.2%) were initiated. In the five-year period from 2010 to 2015, 27 chapters (27.3%) were initiated. A vast majority of chapter officers (n=121, 96.8%) noted that their chapters are officially recognized student organizations on their campuses. The last four chapters (3.2%) are in the process of gaining recognition as an official student organization.

The Chapter Officer Survey requested information on expenses/revenue and revenue spent on travel versus programming. Forty-five chapters provided expense information and 43 provided revenue information. The mean expense amount was $9,372 while the mean revenue amount was $9,513. This indicates that the chapters are effectively managing their budgets with a $141

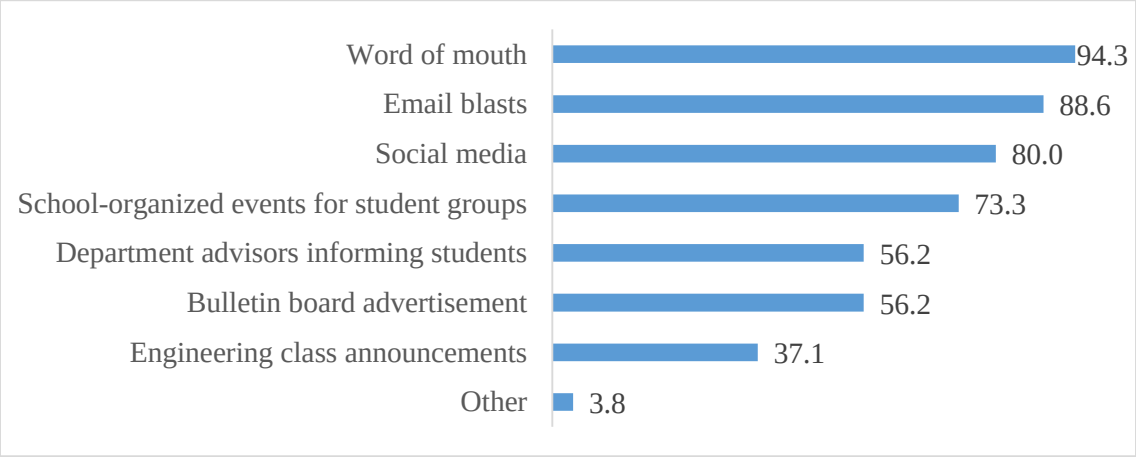
surplus when expenses are compared to revenue (this may have equalized if the same number of chapters that provided expense information had provided revenue information). Forty-two chapters provided information on the percentage of revenue spent on travel versus programming. On average, these chapters spent nearly three-quarters of their revenue on travel (70.0%) versus 27.8% on programming.

There were 107 chapters that provided membership information. Collectively these chapters indicated they have 3,935 members. This is an average of 36.8 students per chapter. Of the total number, 93.2% are undergraduate students and 6.8% are graduate or some other classification level students. The averages per level are:

- Freshmen: 8.8
- Sophomore: 8.6
- Junior: 8.4
- Senior: 8.5
- Master's Level: 1.7
- Doctoral: 0.4
- Other Level: 0.4

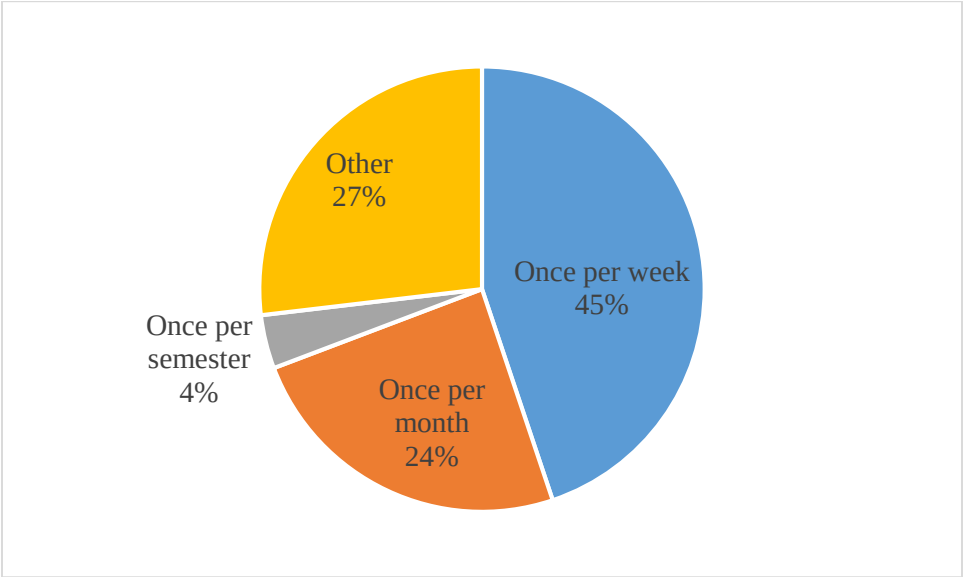
In addition to providing information on membership, the officers noted their recruitment methods. A recruitment method checklist was provided for survey respondents. Figure 2 presents the results.

Figure 2: Chapter recruitment methods (n=105)



The average number of advisors per chapter is 1.5. Advisors reported the number of times, on average, they consult with the chapter during the typical semester. This information is reported in Figure 3.

Figure 3: Typical amount of time advisor consults with the chapter



Both chapter officer and advisors ranked the type of support the advisors provide the chapters. This information is displayed in Table 1.

Table 1: Support provided by advisors

	Chapter Officers (n=108)	Percentage	Advisors (n=77)	Percentage
Connecting with new partners	45	41.7%	42	54.5%
Governance (managing the chapter)	45	41.7%	45	58.4%
Academic advising/tutoring	41	38.0%	47	61.0%
Event planning	40	37.0%	58	75.3%
Individual student counseling	36	33.3%	50	64.9%
Fundraising	31	28.7%	50	64.9%
Recruitment	31	28.7%	45	58.4%
Other	16	14.8%	11	14.3%

Table 1 displays a marked difference between the type of support chapter officers perceive their advisors offer and the type of support advisors believe they offer. For example, chapter officers note that Connecting with New Partners and Governance are the primary methods of support provided by their advisors. However, advisors believe they support most in Event Planning, Individual Student Counseling, and Fundraising. Across the board, more advisors believe they're offering all types of support than do chapter officers.

The chapter officers were asked to provide their perception of the most impactful assistance they received from their advisor. There were 77 officers who provided comments. The comments were content-analyzed to identify the main themes. Table 2 displays the themes and includes a sample comment that represents the meaning of the theme.

Table 2: Impactful assistance from advisors

Theme	N	Percent	Representative Comment
Fundraising	26	33.8%	Helped ensure our application for funding was submitted and that we received the maximum amount.
Event Planning/Travel	17	22.1%	Managing our convention progress
Management	16	20.8%	Personal member and chapter support and advice, financial organization, liaison between our chapter and the university, advocate on NSBE behalf
Academic support	13	16.9%	Organizing Tutoring during Finals and Midterms week each quarter
Advocacy	5	6.5%	Gathering an audience with the dean of the school of engineering and technology when racial tensions were increasing across campus.

More about the advisors

Who are the advisors? The survey requested some information on their previous NSBE experiences. 88 advisors provided information in this area.

NSBE member as undergraduate or graduate student: 24 (30.8%)

NSBE chapter officer as a student: 15 of 24 (62.5%)

Current NSBE member: 45 of 88 (57.7%)

Motivation to be an advisor

- Help students succeed (n=31, 43.7%)
- NSBE Mission (n=21, 29.6%)
- STEM diversity commitment (n=13, 18.3%)
- Chapter development (n=6, 8.5%)

The advisors were asked to state what motivated them to serve in this role. The comments were content-analyzed to identify themes. Primarily the advisors like to help students succeed. An advisor noted, for example, “I enjoy supporting the students and working to make the culture in the College more supportive and conducive to their academic and professional success.”

Nearly 30% of the advisors noted a commitment to the NSBE mission (n=21, 29.6%). An advisor commented, "I am a professional member of NSBE and have been a member since I was an undergraduate student. I understand the benefit of this organization and want to share that with my students."

Chapter officers and chapter advisors were asked to provide their perceptions of chapter status. The survey options were:

- Excelling: Consistently high membership that offers high quality activities annually OR new chapter developing past expectations
- Good: Chapter has maintained itself. Activities offered vary by year OR new chapter meeting expectations
- Fair: Membership is inconsistent but chapter has maintained itself. Activities are sometimes offered OR new chapter meeting some expectations
- Challenged: Efforts to increase membership have not be successful OR new chapter not meeting expectations
- Uncertain

Figure 4 compares the percentages of advisors and officers that perceived the status level of their chapters.

Figure 4: Comparison of chapter status perceptions for officers and advisors

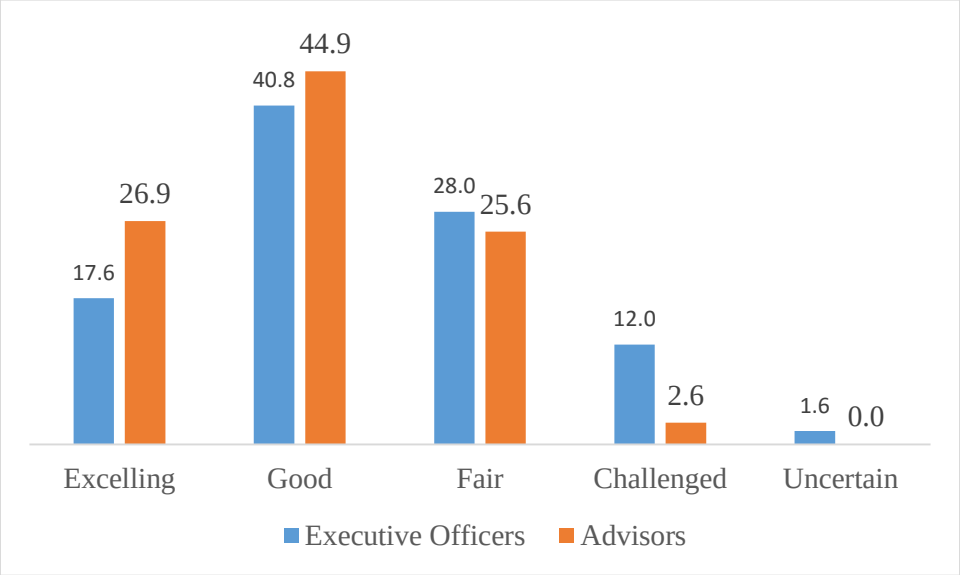


Figure 4 shows that advisors perceive their chapter status at higher levels than the chapter officers. Over 70% (n=56) of the advisors perceive their chapter status as Excelling or Good. Conversely, 58.4% (n= 73) of the chapter officers perceive their chapter status as Excelling or Good.

Chapter activities (study question 2):

The activities in which chapters participate can loosely be grouped into chapter-focused activities and outreach-oriented activities. The chapter focused activities include tutoring, study groups, skill development workshops, mentoring, and social activities. The outreach-oriented activities include K-12 activities and community activities.

Chapter-focused activities: Chapters conduct multiple activities to contribute to student retention and graduation. One is participation in the NSBE Retention Program. The inset below provides the retention program directly from the NSBE website.

NSBE Retention Program

The NSBE Retention Program is our signature academic excellence program designed to keep members enrolled in an engineering program, and help them graduate with an engineering degree. The goal of the NSBE Retention Program is to improve the graduation rates of Blacks in the field of Science, Technology, Engineering and Mathematics (STEM).

The NSBE Retention program has 3 main areas of focus that are designed to help students succeed. Each component of the program benefits all students, regardless of classification, and aims to truly develop each person that participates in the program. The three areas of the retention program are Skill Development Workshops, Study Halls, and Mentorship.

Skill Development Workshops: This area of the retention program focuses on enhancing the academic and professional development skills of members participating in the program.

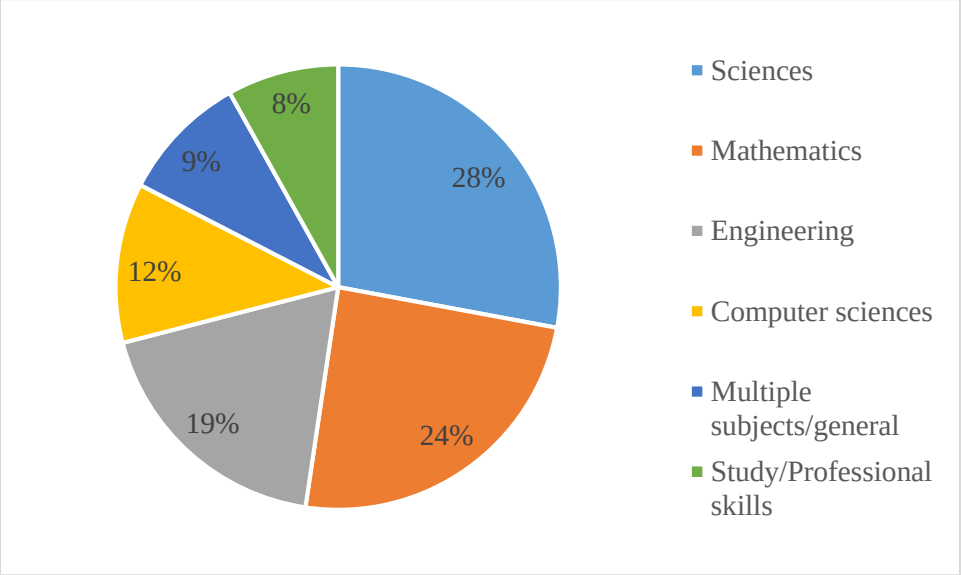
Study Halls: This area of the retention program focuses on encouraging students to work together with each other, tutors, and different faculty to help improve the students understanding of course material.

Mentorship: This area of the retention program focuses on pairing students with either upperclassmen or professionals for them to serve as resources for the student.

There were 56 chapters (54.9%) of 102 reporting institutions that stated they were part of the NSBE Retention Program. It is important to note that many chapter-focused activities could fall into the three categories under the retention program; the survey asked specifically about each of the three areas in an attempt to parse out those activities.

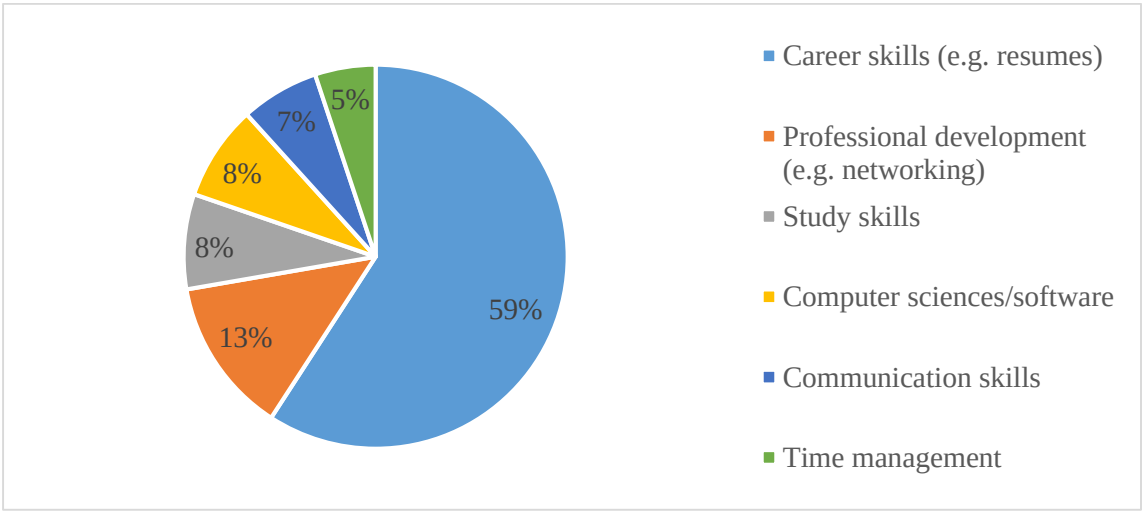
Approximately 75 chapters responded to whether or not they conducted Study Group Sessions during AY15 with 63 stating they did conduct sessions. There were 1,074 Study Group Sessions for an average of 17.0 per chapter. Overall 1,074 undergraduate and 77 graduate students participated in the workshops. There was an average of 12.8 participants per study session. As a note, the number of chapters reporting participant numbers was lower than the number of chapters reporting activity numbers, which may explain why the average number of participants is so close to the average number of sessions conducted. Figure 5 displays the Study Group Session content areas.

Figure 5: Study group session focus areas



Skill Development Workshops are an element of the NSBE Retention Program. Approximately 70 chapters reported on whether or not they conducted Skill Development Workshops during AY15 with 90% stating they did conduct workshops. There were 226 skill development workshops completed for an average of 3.6 per chapter. Overall 1,317 undergraduate and 112 graduate students participated in the workshops. This represented an average of 15.5 students per workshop. Figure 6 displays the skill development workshop content areas.

Figure 6: Skill Development Workshop content areas



Mentoring is an element of the NSBE Retention Program. There were 71 chapters that reported on whether they conducted mentoring activities. A total of 591 undergraduates (12.6 per reporting chapter) and 24 graduate students (2.4 per reporting chapter) documented students receiving mentoring. It is informative to consider who the mentors were. A total of 402 mentors (8.9 per chapter) were chapter members, and 71 mentors (2.4 per chapter) were institution faculty.

Social activities are also part of what chapters offer. A total of 83 chapters reported whether or not they conducted social activities with 89% reporting that they conducted at least one activity. The chapters reported offering 306 activities (4.1 per chapter) with 1,260 participants (17.0 per social event). It is likely that students were double counted. The Chapter Officers, however, reported the average number of participants per social event.

Outreach-oriented activities: For the purposes of this study, outreach-oriented activities are K-12 and community-related. Approximately 80 chapters (78%) reported on K-12 activities. Table 3 details the activity type, total and mean activities, and total and mean participants. Table 3 includes only the chapters that reported one or more activities.

Table 3: Activities conducted in the 2014-2015 academic year

	N	Total (Mean) Activities	N	Total (Mean) Participants
K-8 programs designed to increase engineering interest	44	213 (4.8)	40	950 (23.8)
High school programs designed to increase engineering interest	46	173 (3.8)	42	771 (18.4)
Programs to provide K-12 educators with resources/methods to increase student engineering interest	28	113 (4.0)	25	239 (9.6)
Bridge programs designed to prepare students for college	32	75 (2.3)	28	456 (16.3)
Combined	--	574 (3.8)	--	2416 (17.9)

The K-12 activities focused on the K-8, high school, educator, and bridge levels. During AY15, reporting chapters conducted 574 activities (3.8 per chapter). These activities impacted 2,416 students and educators (17.9 per chapter). As a caveat, it is unknown whether there were students that were double counted when the chapters were reporting. The outreach to the educators has a multiplier effect. Two hundred thirty-nine K-12 educators were provided with resources and methods to increase student engineering interest. If each educator applied these resources and methods with ten K-12 students, another 2,390 students would be impacted by the chapter outreach. It is not possible for this study to define the extent of the outreach but this is an activity type that would have a multiplier effect.

Chapter officers also reported on community activities. A total of 61 chapters (60%) reported conducting at least one activity. Overall, there were 288 community activities (4.7 per chapter). These activities included 1,484 participants (27.0 per chapter). The Chapter Officers also reported the average number of chapter participants per activity. The overall average was 12.3 per activity. A total number is not reported here as it is likely that chapter members were double counted. Mentoring represents another K-12 outreach activity. Nineteen chapters reported mentoring 253 precollege students. This represented an average of 13.3 per chapter.

Assessment methods (study question 3)

The specific assessment methods questioned included Student Tracking, Participants by Activity, Activity Evaluations, Chapter Alumni Tracking, Chapter Vitality, and Other Assessment methods. The purpose was to gain an understanding of how chapters are determining the success of their activities. The Chapter Officer Survey was the data source for this information. Overall, 100 chapters indicated the assessment methods utilized. Figure 7 displays the results.

Figure 7: Assessment methods chapters employ

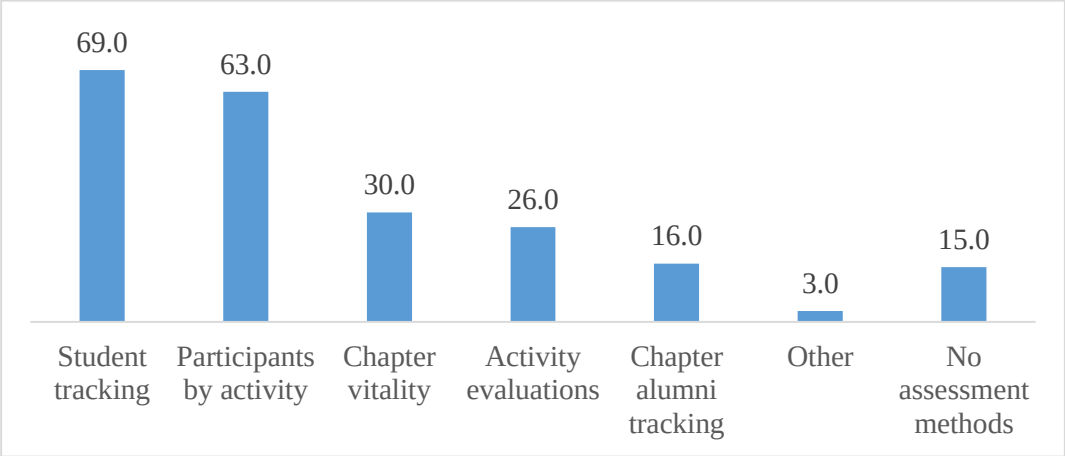


Figure 7 displays the most commonly employed assessment methods are Student Tracking of Chapter Members (n=69, 69.0%) and Participants by Activity (n=63, 63.0%). No other assessment method was employed by a majority of chapters. It is noteworthy that 15% of reporting chapters indicated that they do not engage in any assessment activities.

Chapter outputs (study question 4)

The specific output types considered in this study are scholarship attainment, grade point average, and graduation. The graduation section includes information on graduate school, and employment. It is important to note that there was a great deal of missing data or data not entered correctly in these areas; only complete information is commented on.

Scholarship attainment: Chapter advisors were asked to provide information on the number of students that applied for and earned a NSBE scholarship in AY15. Twelve chapters had one or more applicants for the scholarship. Table 4 provides information on scholarship earners.

Table 4: Scholarship statistics by chapter

Student Level	Total Applicants	Recipients	Average Award Amount
Undergraduates	77	19	$20,500
Graduates	6	0	--

Of the undergraduate applicants reported, 24.7% successfully earned a scholarship. No graduate applicant successfully earned a NSBE Scholarship.

Grade point average: A high percentage of chapters report having a designated individual to track student GPAs (n=54, 69.2%). The number of advisors that reported this information, however, was low. Table 5 displays the number of chapters that reported GPA and the descriptive statistics associated with that information.

Table 5: GPA statistics by chapter

Student Level	N	Sample Mean	Population Mean	Sample Minimum	Sample Maximum
Freshman	20	3.08	3.13	2.7	4.0
Sophomore to Senior	21	2.99	3.09	2.8	3.3
Graduate	14	3.41	3.49	3.0	4.0

It is noteworthy that the undergraduates in both the sample and the population are maintaining a GPA of approximately 3.0. This indicates that the students are being successful despite the general rigor of engineering courses.

Retention and persistence: The Chapter Advisor Survey requested information on AY15 Freshmen chapter members and whether they returned to school in AY16. There were 22 chapters that reported information on freshmen and sophomore status. Those chapters reported that in AY15, there were 291 freshmen with 242 persisting to their sophomore year. This represented a retention rate of 83.2%. In AY16, 38 of those 242 students changed majors. This represents an engineering program retention percentage of 84.3%.

The Chapter Advisor Survey also requested information on AY15, sophomore chapter members and whether they returned to school in AY16. There were 18 chapters that reported information on sophomore and junior status. In AY15, there were 206 sophomores with 172 persisting to their sophomore year. This represented a retention level of 83.5%. In AY16, 20 students changed majors. This represents a retention percentage of 88.4%.

Degree attainment: Degree attainment is the ultimate success indicator. Advisors were asked to respond to the statement “What strategy do you believe is most effective in helping students persist and earn their engineering degree at your institution?” Forty-seven advisors provided comments. The comments were content analyzed to identify major themes. Table 6 provides the themes identified.

Table 6: Strategies that support academic success

Theme	N	Percentage	Representative Comment
Institution Support/ Pedagogy	25	53.2%	This can differ based on race and gender, but overall the most important is academic and professional development support, and helping them develop a strong cohort of peers.
Support Network	14	29.8%	Developing a connection with their major through faculty and experiential support. Student-centered approach from a student-development theory pedagogy. Building a sense of community and belonging to the campus through partnerships and informal gatherings.
Academic Skills	6	12.8%	Helping students develop strong study skills, test-taking skills, and managing time is key for their success.
Precollege	2	4.3%	Pre-college program is also helpful; being prepared as a pre-college students is most helpful.

It is strategies such as these the advisors employed to support degree attainment. Thirteen chapters submitted complete data on their AY15 bachelor degree earners. For these chapters, 69 chapter members earned bachelor degrees. Of the degree earners, 34 (49.3%) are pursuing a graduate degree. Thirty (43.5%) other graduates have obtained employment in an engineering field. This indicates that 92.8% have persisted in engineering past bachelor degree attainment.

Seven chapters reported complete information on AY16 graduate degree earners. For these chapters, 29 students earned graduate degrees. Eight (27.6%) graduates are continuing their education to earn an additional engineering degree. Eighteen (62.1%) graduates have gained employment in an engineering field. Overall, this indicates that 89.7% of the graduate degree earners are currently persisting in the engineering field.

Impact of fundraising on academics: The chapter advisors were asked to provide their perception on the relationship between fundraising and academics at their chapters. These results are presented in Table 7.

Table 7**:** Relationship between fundraising and academics

	N	**%**
Fundraising is not a concern for my chapter, as we receive funding from our school, corporate sponsors, etc.	8	11.9%
My chapter balances fundraising and academics very well.	32	47.8%

	N	%
My chapter sometimes struggles with fundraising; my perception is that it may be impacting the academic success of students involved in these activities.	12	18.0%
My chapter constantly struggles with fundraising; my perception is that it may be impacting the academic success of students involved in these activities.	11	16.4%
Not applicable/I don't have an opinion on this.	4	6.0%

It is noteworthy that a majority of Advisors (n=40, 59.7%) perceive that fundraising does not impact chapter member academics.

Impact

A preliminary analysis of the impact of the chapters' activities on student success was conducted using GPA as the measure of success. Collegiate members supply NSBE with this information via the membership application (for new memberships and renewals). For this analysis, GPA means were calculated for chapters with 10 or more members who provided their GPAs (those with fewer than 10 were excluded because the mean GPA was more likely to be impacted by extremes). Overall, 101 chapters had more than 10 members reporting their GPAs; 20 of those were removed because they did not complete the survey, leaving 81 chapters for analysis.

The specific activities investigated for this impact analysis were NSBE Retention Program participation, chapter tutoring, general chapter retention programs, study groups, skill development workshops, and undergraduate mentoring. T-tests were conducted to determine if a mean GPA difference exists between chapters that did and did not report participating in these activities.

There are general cautions associated with this analysis. One is that the GPAs and the activities are self-reported. Additionally, it would be more accurate to have student level data in terms of whether a student has or has not participated in the activities studied here. This analysis does, however, give an initial indication on whether NSBE is impactful in these areas in terms of GPA.

NSBE Retention Program

The first area evaluated for GPA impact is the NSBE Retention Program. The survey asked the respondents to state whether their chapter is or is not a program participant. Table 8 provides descriptive statistics on the mean GPA based on chapter participation status.

Table 8: NSBE Retention Program GPA descriptive statistics

	N	Mean	SD
Retention Program Participant	47	3.06	.18
Non-Retention Program Participant	33	3.03	.18

As a first step in the analysis, a Levene's Test for Equality of Variances was conducted and found no variance difference between the groups (F=.02, p=.893).

An independent samples t-test with equal variances assumed was conducted to determine if there is evidence of a mean GPA difference between chapters that do or do not participate in the NSBE Retention Program. Test results indicated that there is no evidence of a mean GPA difference between groups that do and do not participate in the NSBE Retention Program (t=.71, df=78, p=.483). The 95% confidence interval of the difference between GPAs is between -.05 to .11.

Tutoring programs

The second area evaluated for GPA impact is whether the chapters offer tutoring. The survey requested that the chapter identify whether they conducted tutoring events. Table 9 provides descriptive statistics on the mean GPA based on whether they conducted tutoring events.

Table 9: Tutoring GPA descriptive statistics

	N	Mean	SD
Tutoring Events	62	3.07	.18
No Tutoring Events	11	3.02	.18

As a first step in the analysis, a Levene's Test for Equality of Variances was conducted and found no variance difference between the groups (F=.15, p=.702).

An independent samples t-test with equal variances assumed was conducted to determine if there is evidence of a mean GPA difference between chapters that do or do not have tutoring events. Test results indicated that there is no evidence of a mean GPA difference between groups that do and do not have tutoring events (t=.85, df=71, p=.398). The 95% confidence interval of the difference between GPAs is between -.07 to .17.

Chapter retention programs

The third area evaluated for GPA impact is whether there are chapter retention programs. The survey requested that the chapter identify whether they have conducted general chapter retention programs. Table 10 provides descriptive statistics on the mean GPA based on whether they conducted general chapter retention programs

Table 10: General chapter retention program GPA descriptive statistics

	N	Mean	SD
General Chapter Retention Programs	48	3.06	.17
No General Chapter Retention Programs	17	3.00	.20

As a first step in the analysis, a Levene's Test for Equality of Variances was conducted and found no variance difference between the groups (F=.61, p=.437).

An independent samples t-test with equal variances assumed was conducted to determine if there is evidence of a mean GPA difference between chapters that do or do not have general chapter retention programs. Test results indicated that there is no evidence of a mean GPA difference between groups that do and do not have general chapter retention programs (t=1.17, df=63, p=.246). The 95% confidence interval of the difference between GPAs is between -.04 to .16.

Study groups

The fourth area evaluated for GPA impact is whether the chapter conducted study groups. The survey requested that the chapter identify how many study groups they conducted. Table 11 provides descriptive statistics on the mean GPA based on whether they did or did not conduct study groups.

Table 11: Study group GPA descriptive statistics

	N	Mean	SD
Study Groups	53	3.06	.18
No Study Groups	10	2.96	.12

As a first step in the analysis, a Levene's Test for Equality of Variances was conducted and found no variance difference between the groups (F=.82, p=.368).

An independent samples t-test with equal variances assumed was conducted to determine if there is evidence of a mean GPA difference between chapters that do or do not conduct study groups. Test results indicated that there is marginal evidence of a mean GPA difference between groups that do and do not have general chapter retention programs (t=1.66, df=62, p=.103). The 95% confidence interval of the difference between GPAs is between -.02 to .22.

The correlation between the number of study groups conducted and the mean GPA was derived. The correlation in this area was.16 (p=.213). This was also marginally significant.

Skill development workshops

The fifth area evaluated for GPA impact is whether the chapter conducted skill development workshops. The survey requested that the chapter identify how many skill development workshops they conducted. Table 12 provides descriptive statistics on the mean GPA based on whether they did or did not conduct skill development workshops.

Table 12: Skill development workshop GPA descriptive statistics

	N	Mean	SD
Skill Development Workshops	56	3.06	.16
No Skill Development Workshops	7	2.97	.15

As a first step in the analysis, a Levene's Test for Equality of Variances was conducted and found no variance difference between the groups (F=.01, p=.903).

An independent samples t-test with equal variances assumed was conducted to determine if there is evidence of a mean GPA difference between chapters that do or do not conduct skill development workshops. Test results indicated that there is marginal evidence of a mean GPA difference between groups that do and do not have skill development workshops (t=1.40, df=61, p=.168). The 95% confidence interval of the difference between GPAs is between -.04 to .22.

Correlation results in this area were also marginally significant. The correlation between the number of skill development workshops and mean GPA is .20 (p=.108).

Mentoring programs

The last area evaluated for GPA impact is whether the chapter mentors undergraduates. The survey requested that the chapter identify how many undergraduate students receive mentoring. Table 13 provides descriptive statistics on the mean GPA based on whether they did or did mentor undergraduate students.

Table 13: Undergraduate student mentoring GPA descriptive statistics

	N	Mean	Standard Deviation
Undergraduate Mentoring	56	3.06	.16
No Undergraduate Mentoring	7	2.97	.15

As a first step in the analysis, a Levene's Test for Equality of Variances was conducted and found no variance difference between the groups (F=.90, p=.346).

An independent samples t-test with equal variances assumed was conducted to determine if there is evidence of a mean GPA difference between chapters that do or do not mentor undergraduate students. Test results indicated that there is no evidence of a mean GPA difference between groups that do and do not mentor undergraduate students (t=-.02, df=57, p=.983). The 95% confidence interval of the difference between GPAs is between -.10 to .10.

A difference was identified between the t-test results and the correlation. The correlation between the number of undergraduates mentored and the mean chapter GPA is .28 (p=.032). This provides statistically significant evidence between the number of undergraduate students mentored and GPA.

Impact Summary

This analysis identified evidence of NSBE impact on GPA in three areas. There is marginally statistically significant evidence that chapters that conduct study groups and skill development workshops have higher mean GPAs than chapters that do not have these activities. Correlation results on the number of these activities conducted were also marginally statistically significant.

Although there is no evidence of a mean GPA difference between chapters that do or do not mentor undergraduates, a difference was identified. There is a statistically significant correlation between the number of undergraduates mentored and mean chapter GPA.

Discussion

Several interesting trends emerged that relate to the backgrounds of the chapters. Despite being only a five-year period, a quarter of the collegiate chapters were initiated from 2010-2015. This could represent an alignment with the growing emphasis on Science, Technology, Engineering, and Mathematics (STEM) education in the US. Additionally, the recent increase in chapters may demonstrate NSBE is increasing its recognition as an association that can be impactful in increasing diversity in engineering fields at the collegiate level. This is supported by the fact that nearly all of the chapters are recognized as an official student organization at their institutions. However the chapters are not investing their resources in activities that will increase their members' odds of success. Budget allocation demonstrated that chapters spend the vast majority of their budget on travel, as opposed to programming. The relevant question for NSBE to ask is whether this is an appropriate financial allocation. In the analysis of chapter activities, researchers found that the average number of student participants in each social event is higher than the average number of students participating in each study group and mentoring activity. Although there could be several explanations for this finding, NSBE may assess the organization's messaging at the chapter level to ensure that national priorities are communicated.

Understanding advisor contributions represents an opportunity for NSBE to better support the chapters. Advisors provide a wide array of support to the chapters. No method, however, was noted by a majority of chapters. Chapter officers report that their advisors are most impactful in Fundraising, Event Planning/ Travel, and Management. NSBE can examine whether these are the types of impacts that it hopes advisors make. If yes, training or other methods can be employed to better prepare advisors and leverage their strengths. If there are other impacts NSBE hopes advisors can make, interventions can be developed. NSBE stakeholders can also examine the factors that motivate advisors to serve. Understanding these motivations can potentially assist chapters that do not have an advisor identify an appropriate candidate.

The outputs related to GPA, persistence and graduation give evidence that students are achieving in their efforts to enter the engineering field as a professional. Of the AY15 bachelor degree earners, an impressive 92.8% have persisted in engineering either through attending graduate school or by gaining employment in an engineering field. Similarly, 89.7% of the graduate degree earners have persisted in the engineering field either through continued education or full-time employment. These successes are particularly interesting when considering that, while the majority of advisors and executive officers perceive their chapter status positively, only one-quarter or less perceives their chapter is excelling. This represents an opportunity for NSBE to identify methods to increase the number of chapters that have consistently high membership and offer high quality activities.

Although the impact analysis using GPA has some caveats, it provides a preliminary exploration of how chapter activities affect member success. Two activities (skill development workshops and study groups) were associated with marginally statistically significant GPA differences. In working toward strategic plan goals, NSBE may consider a more in-depth analysis of the effectiveness of programming at the chapter level. Creating models that look for significant GPA differences that accompany a combination of these activities would be a next step in this type of research, given that no one single activity had a drastic impact.

In terms of limitations to this study, the surveys given to the students and advisors were extremely robust and designed to extract as much information as possible about the chapter.

Thus, some answers were left blank, leading to different N sizes for most of the variables. It is also possible that the individuals filling out the surveys did not have all of the information requested. While important, the chapters are not collecting information on activity success. Information of this type could be used to increase the effectiveness of chapter activities. Furthermore, only 16% of chapters engage in Chapter Alumni Tracking. Data in this area could be used for two purposes. One is to identify what alumni engage in after graduation (e.g. graduate school, employment). Two, alumni could represent an important resource for the chapter (e.g. internship opportunities, donations). NSBE headquarters may be able to assist the chapters in this area. In any case, it is crucial for organizations like NSBE to define their markers of success and employ tracking methods on both the national and local levels.

Three major takeaways from this research can guide chapter operations within other minority engineering organizations. First, budget allocation, even at the chapter level, should reflect the goals of the organization as a whole. If the focus is on academic excellence, the MEO may advise chapters to put more dollars toward tutoring sessions. If chapters aren't receiving enough money to sustain themselves without straining members, can the national organization assist? Second, tracking methods are crucial to measuring success. MEOs need to define their markers of success and develop tracking methods that chapters can easily use (and access) year over year. Centralizing this data for each chapter would benefit both the chapter itself, and the national organization, allowing each to discern patterns and design programming to redress any issues. Finally, feedback from all stakeholders is crucial to improvement. Individuals with varying relationships to the MEO may have different perceptions of challenges and opportunities their chapters (and, more broadly, the national organization) face. Soliciting input from individuals with varying involvement in the organization will inform and encourage robust refocusing where it is needed.

In the future, minority engineering organizations should conduct similar studies to better understand the characteristics, activities, and outcomes of their chapters. Given the quality of the data, it would be interesting to see correlations between types/frequencies of chapter events and measures of success. Such a study would provide the MEO with a prescriptive blueprint for their collegiate chapter programming designed to increase retention, GPA, and graduation rates. Although MEOs offer tangible extracurricular support to minority students, they cannot enact systemic change in a vacuum. True progress in the advancement of minorities in engineering will come from cooperation between MEOs, policymakers, university faculty and administration, employers of engineers and school districts. Better understanding of their own constituencies will enable MEOs to lead this charge.

Acknowledgements

The authors express deepest gratitude to the researchers from the Evaluation and Action Research Associates for their role in the execution and analysis of this study. The authors also acknowledge Neville Green (National Chair, National Society of Black Engineers) and Karl Reid, Ed.D. (Executive Director, NSBE) for their continued support of this project. Additional support that made this project possible was provided by Tolu Oyelowo (Academic Excellence Chair, NSBE), Eric Addison (editor, NSBE), and Brenda Nathan (web support, NSBE).

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