# Graduate Engineering Rankings Methodology 2023[1]

## Introduction

This report presents the findings of a comprehensive survey conducted by the American Society for Engineering Education (ASEE) in response to a request from US News & World Report (USNWR). The primary aim of this survey was to gather insights from engineering leadership on the validity and reasonableness of using the ratio of graduate students to faculty as a key metric for assessing the quality of engineering graduate programs in university rankings. Recognizing the multifaceted nature of academic program evaluation, ASEE expanded the scope of the survey to include other metrics used by US News & World Report in their rankings.

To ensure a broad and informed perspective, the survey targeted a diverse group of respondents, including deans, associate deans, and reporting staff involved in the ASEE's Profiles of Engineering and Engineering Technology Survey. These individuals, by virtue of their roles and experience, possess a deep understanding of the intricacies and challenges of evaluating engineering education and are thus well-equipped to provide valuable feedback.

The responses gathered offer critical insights into the current state of engineering education evaluation, highlighting the strengths and limitations of existing metrics, and proposing potential avenues for more effective and holistic assessment methods. This report not only sheds light on the opinion of academic leaders regarding the graduate student-to-faculty ratio as a quality measure but also delves into the broader conversation about academic ranking methodologies and their impact on engineering education.

The survey was sent to all members of the Engineering Deans Council and all data contacts for the Profiles of Engineering & Engineering Technology survey. There were 135 respondents from 116 different institutions. Deans constitute the majority of the respondents at 61%, followed by Associate or Assistant Deans at 22%. Respondents who are part of the Institutional Research, Institutional Effectiveness, or Decision Support staff account for 15%. Department Chairs represent the smallest respondent group at 3%.

The results reported are summaries of data and comments made by the respondents. Nothing in this report should be interpreted as an endorsement of a position by the ASEE or its governing bodies of any element of rankings discussed.

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[1] Please email any questions to the report author, Dr. Joseph Roy at j.roy@asee.org . Thank you to all the respondents for their time and thoughtful responses to the survey reported.

## Data Verification and Comparison with US News & World Report

In our ongoing effort to ensure the accuracy and reliability of the data collected, we conduct a meticulous comparison with figures reported by US News & World Report.This comparison is carried out using the data submitted to us in early January, which is prior to the conclusion of our survey season. Acknowledging that our survey cycle is not perfectly aligned with that of USNWR, we initiate a follow-up round of comparison in February to further corroborate the data accuracy.

One of the key aspects of this process involves requesting institutions to explain any significant discrepancies or notable year-to-year variations in their submitted data. Such inquiries are not uncommon; in the last year alone, we reached out to 24 institutions specifically regarding their reported research expenditures. This led to three instances where the submitted numbers to ASEE were revised, underscoring the importance of our verification process.

We undertake this process to ensure institutions have a chance to correct or explain any discrepancies before the data becomes public. Discrepancies between our data and that reported to USNWR, as well as substantial fluctuations in year-to-year data, can cast doubt on the validity of the information provided. Therefore, our approach is designed to identify and rectify any such issues promptly.

## Faculty to Student Ratios in Engineering Graduate Programs

**Is the ratio of the number of doctoral students to faculty a good measure of faculty productivity?**: A majority of respondents, 54.92%, believe that it is a good measure for doctoral students, indicating more than half find this metric favorable. However, a significant minority, 29.51%, do not agree with using this ratio as a measure of productivity, suggesting there is some contention about its effectiveness.

The comments on whether the ratio of doctoral students to faculty is a good measure of faculty productivity in graduate engineering programs reveal a spectrum of views. Here is a summary of the key points in the responses:

Support for the Ratio as a Metric**:**

- The ratio is seen as indicative of available funding from grants, with a productive faculty member often supporting 5-6 doctoral students.
- Higher research expenditures per faculty may translate to the ability to support more graduate students, though some funds may go to research scientists and postdocs instead.
- The number of doctoral students per faculty is typically reflective of faculty funding success, translating to research productivity.

Concerns and Limitations:

- The metric does not necessarily reflect the level of faculty scholarship, may favor experimental programs, and does not account for students supported by research professors.
- It is suggested that while the ratio might correlate with research funding, it is a duplication of assessment since the absolute dollars a principal investigator brings in are counted elsewhere.
- Quality of mentorship and advising quality may diminish with larger numbers of students.
- The ratio does not capture the quality of mentoring provided, with concerns about it leading to a 'factory' model where students get less attention.
- The metric is seen as too broad and not a direct measure of faculty productivity, failing to consider other contributing factors.

Contextual Considerations:

- The nature of the institution and how faculty are defined play significant roles in the relevance of this metric.
- The ratio may disadvantage schools starting new doctoral programs, those with diverse student bodies requiring more support, and institutions with large endowments or gifts allowing for more fellowships.

Alternative Views and Suggestions:

- Some respondents suggest that the number of PhD graduates per faculty or the number of grant-supported doctoral students might be more meaningful measures.
- It's proposed that a balance or 'sweet spot' exists for the ratio, dependent on the field of study and research nature.
- Other productive faculty with few graduate students suggest that productivity can also be high without a large number of doctoral students.

Broader Implications:

- The production of students is tied to the impact of research; if faculty can't fund or graduate students, it may reflect lower research activity.
- The metric should align with the broader mission of graduate programs in training and research impact.
- It is essential to distinguish between different types of faculty (tenure-track vs. teaching faculty) and types of doctoral student support (teaching assistantships vs. research funding) when using this measure.

While there is recognition that the doctoral students-to-faculty ratio can reflect aspects of faculty productivity, there is also significant concern about its limitations and potential

misrepresentation of program quality. The consensus leans towards a more nuanced approach that considers multiple facets of productivity and the educational mission.

**Would the opposite directionality for this variable (i.e. a lower ratio of doctoral students to faculty) measure other important characteristics of the institutions graduate engineering program's quality?:** The majority, 52.94%, do not believe that a lower ratio would be indicative of program quality. In contrast, 28.57% of respondents feel that a lower ratio could indeed reflect other significant aspects of a program's quality.

The comments for this question about whether a lower ratio of doctoral students to faculty would measure important characteristics of a graduate engineering program's quality are mixed. Some respondents see a lower ratio as potentially indicative of more personalized attention and mentorship for students, while others question the link between lower student-to-faculty ratios and program quality. Concerns are expressed that too few doctoral students could suggest lower productivity or a lack of research activity. The context, such as the institution's mission and the nature of the research, is deemed crucial in interpreting this metric. There's a suggestion that an optimal ratio might exist, but it would vary by discipline and type of research, making a one-size-fits-all metric impractical. Additionally, some respondents highlight that having fewer students might allow for better quality advising and a more intensive educational experience, but caution that other measures would be needed to confirm this.

**Master’s Programs:** In the evaluation of the master’s programs, the survey data indicates a clear consensus among the respondents regarding the use of the student-to-faculty ratio as a measure of faculty productivity. Only 27% of respondents agree that a higher student-to-faculty ratio should be positively associated with faculty productivity, suggesting that a greater number of master’s students per faculty member is a valid indicator of a faculty's work output. Conversely, an even smaller percentage, 17%, believe that a lower ratio, which could imply more intensive faculty-student interactions, should be considered a negative indicator of productivity.

The nuanced roles of master's programs in the modern educational landscape, ranging from research to professional development, require more sophisticated metrics that can capture the diverse outputs of faculty engagement. This involves not only their research achievements but also the quality of mentorship and instruction they provide, particularly in settings where master's students may not be directly involved in research activities. The feedback implies that ranking systems and productivity assessments should consider alternative metrics that reflect the multifaceted contributions of faculty to graduate education beyond simple enrollment figures. The survey comments indicate a nuanced view of the ratio of master's students to faculty as a measure of faculty productivity. Some respondents highlight that master's students are often more focused on coursework than research, which means a higher ratio may not reflect research productivity but could indicate a commitment to workforce development as master's degrees become the new entry-level requirement in engineering. There's a distinction made between research-oriented master's programs and professional, non-thesis, or online programs, with the

latter often viewed as revenue generators that do not necessarily contribute to research output or faculty productivity.

Several comments point out that while doctoral students typically engage in research that may enhance faculty productivity, master's students do not always do so, particularly in coursework-based programs. Therefore, a high number of master's students may simply indicate a program's size or its focus on professional training rather than its research strength or the quality of faculty mentorship. Some suggest that the metric might be more relevant if it were limited to thesis-based master's students who contribute to research.

The overall sentiment is that the master's student-to-faculty ratio is a less reliable indicator of faculty productivity compared to the doctoral student-to-faculty ratio. The quality of mentorship, the type of master's program, and the role of master's students in research activities are important factors to consider when using this metric to assess faculty productivity. A holistic view that considers the nature of the master's programs and the types of degrees offered is necessary to understand the implications of this ratio. The quality of education, the institution's mission, and the impact of the graduate program are also highlighted as important factors beyond mere numbers.

This significant agreement among respondents reflects skepticism about the correlation between the quantity of master's students and the quality of faculty productivity. It suggests that the complexity of master's education, with its blend of research-oriented and professional coursework-focused programs, renders the student-to-faculty ratio too blunt an instrument for gauging faculty performance.

**Changes from 2022 to 2023**

From 2022 to 2023, there were substantial changes, summarized below, for the weights assigned to various variables for the ranking of graduate engineering programs by US News & World Report.

- **Total Research Expenditures**: Weight increased from 0.15 in 2022 to 0.3 in 2023 (a 100% increase).
- **Average research expenditures per (TT) faculty member**: Also saw a 100% increase in weight from 0.1 to 0.2.
- **Peer Assessment Score**: This variable's importance decreased by 50%, from 0.25 to 0.125.
- **Recruiter Assessment Score**: Decreased by 16.7%, from 0.15 to 0.125.
- **Doctoral Degrees Awarded**: Increased by 44.0%, from 0.0625 to 0.09.
- **Doctorate to Faculty ratio**: Decreased by 46.7%, from 0.075 to 0.04.
- **Masters to Faculty ratio**: Similarly decreased by 46.7%, from 0.0375 to 0.02.
- **Percentage of Faculty in National Academy of Engineering**: Decreased by 33.3%, from 0.075 to 0.05.
- **Acceptance Rate**: The importance of this variable increased significantly by 53.8%, from 0.0325 to 0.05.

- **Mean GRE scores**: This variable had a weight of 0.0675 in 2022, but in 2023 it's not assigned any weight.

**How do the changes in weights from 2022 to 2023 for each variable affect the ability to measure ranking of engineering graduate programs:** The two figures below reveal survey responses about the perceived impact of weight changes for different variables on the ability to measure the rankings of engineering graduate programs from 2022 to 2023.

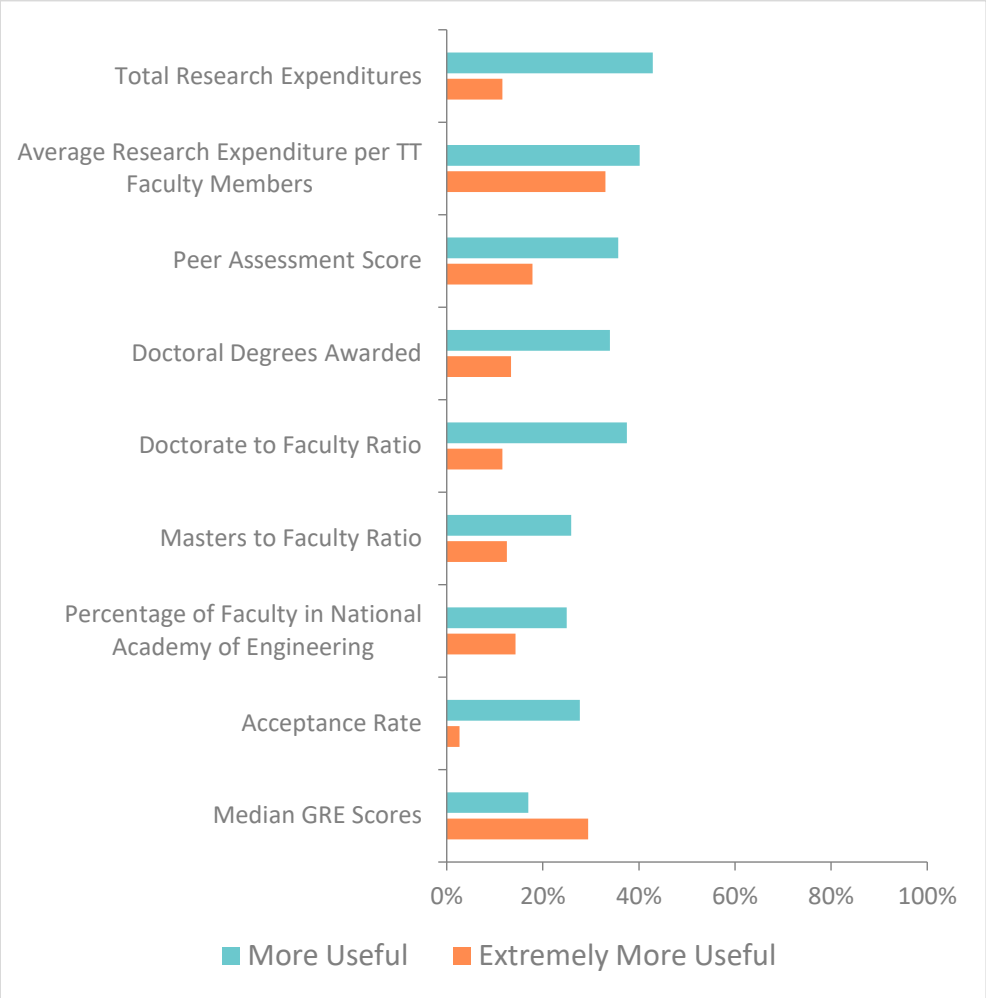


*Figure 1: How does the change in weights from 2022 to 2023 for each variable affect the ability to measure ranking of engineering graduate programs?*

In Figure 1, responses indicate that variables such as "Total Research Expenditures" and "Average Research Expenditure per TT Faculty Members" are considered significantly more useful by many participants. This perception is likely due to the increased emphasis these variables received in the 2023 rankings. Conversely, the "Peer Assessment Score" sees a mix of opinions, with some respondents considering it extremely more useful despite its decreased weight, suggesting that its value in the ranking process remains recognized.

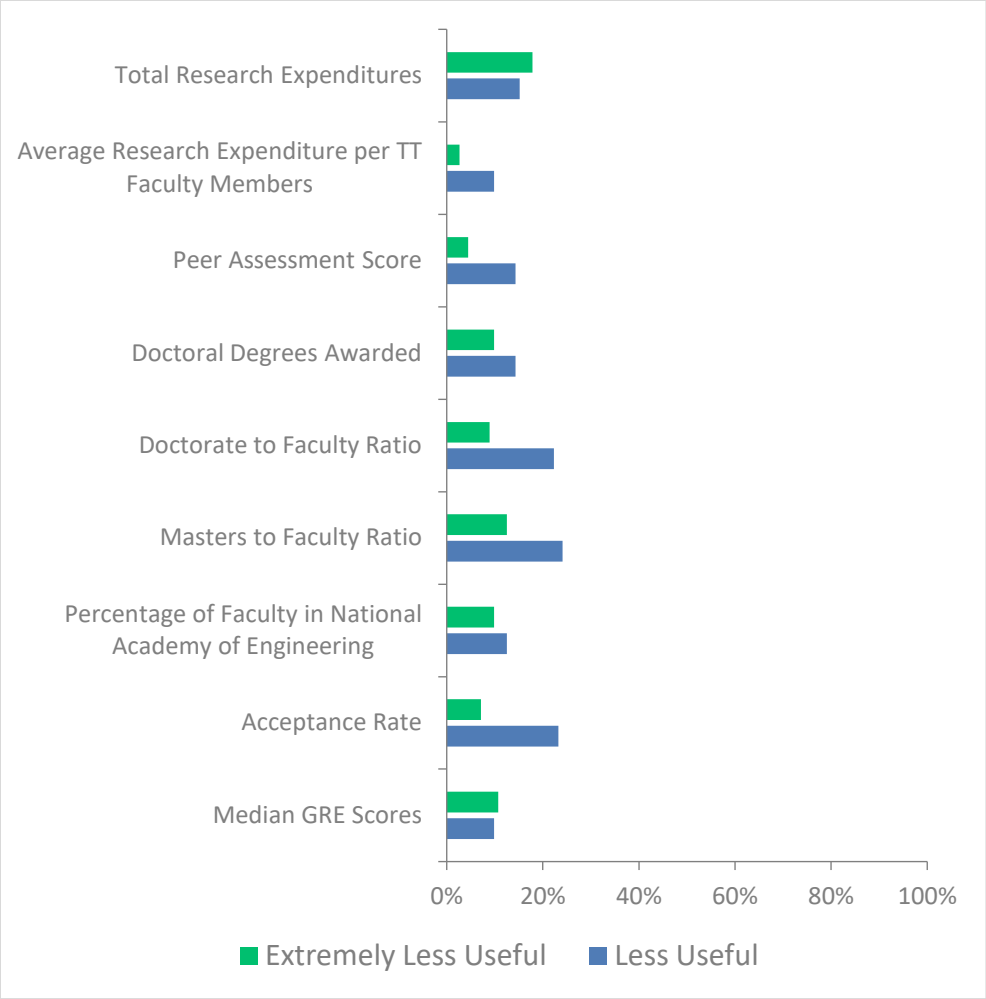


*Figure 2: How does the change in weights from 2022 to 2023 for each variable affect the ability to measure ranking of engineering graduate programs?*

Figure 2 contrasts these views, with a majority of respondents labeling "Total Research Expenditures" and "Average Research Expenditure per TT Faculty Members" as less or extremely less useful, which is intriguing given their higher weights in the latest rankings. The "Peer Assessment Score" is mostly deemed less useful, aligning with its lower weight in 2023. Other variables like "Doctoral Degrees Awarded," "Doctorate to Faculty Ratio," and "Masters to Faculty Ratio" are predominantly seen as less useful, reflecting their reduced weights. Additionally, "Percentage of Faculty in National Academy of Engineering" and "Acceptance Rate" garner mixed reactions but generally tend towards being less useful in the respondents' views. The "Median GRE Scores" stand out, with an overwhelming consensus on its decreased usefulness, coinciding with its removal from the weightings.

The surveys encapsulate diverse opinions on the utility of these variables after the weight changes, illustrating a complex landscape of perceptions among those assessing the rankings of graduate engineering programs. Some respondents view the increased

weights as enhancing the variables' utility, while others believe the changes render them less useful for ranking purposes.

The comments also reflect a range of opinions on the changes to the US News & World Report's ranking methodology for engineering graduate programs. Many respondents express concerns that the updated weights, especially the increased emphasis on total research expenditures, favor larger institutions and may not accurately reflect the quality of the programs. The use of total research expenditures as a metric is critiqued for benefiting schools with more faculty, as it does not account for the productivity or quality of research.

While several comments acknowledged that per capita measures, such as research expenditures per tenure-track (TT) faculty member, are an indicator of program quality, as it normalizes for size and focuses on individual faculty contributions, some raised the issue of the inclusion of research expenditures on projects led by non-tenure track faculty. Effectively, institutions will large amounts of research professors can increase the amount of expenditures without increasing the number of tenure-track faculty used in the per capita measure for ranking.

The decrease in the importance of GRE scores is generally seen as positive, aligning with a trend towards holistic admissions practices. However, some note that the GRE was one of the few metrics where smaller programs could compete. Concerns are also raised about the use of peer assessment scores, which are seen as lagging indicators and subject to bias. The inclusion of faculty membership in the National Academy of Engineering is criticized for bias towards older, established schools and not necessarily indicative of the current quality of graduate education.

Some comments call for more outcome-focused metrics, such as citations or papers per faculty, and caution against metrics that can be inflated through creative accounting or that do not measure the graduate experience's quality. There's a sentiment in several responses that the rankings should reflect more than just research funding and peer impressions and that teaching quality, mentoring, curriculum, and job placement are also important but not captured in the current data.

Overall, there is a request for the inclusion of more objective measures of faculty effort and productivity. The changes are seen by some to disproportionately benefit larger institutions and do not necessarily align with a comprehensive measure of program quality.

**Utility of Current Variables in Rankings**

Separately from the recent changes, we asked respondents about how useful the variables are that are included in the US News & World report rankings for actually assessing the quality of a graduate engineering program.

Figure 3 indicates respondents' perceptions of the usefulness of various variables for ranking graduate engineering programs, with options ranging from 'Extremely Useful' to 'Useful'. The variables considered include Total Research Expenditures, Average Research Expenditure per Tenure-Track (TT) Faculty Members, Peer Assessment Score, Doctoral Degrees Awarded, Doctorate to Faculty Ratio, Masters to Faculty Ratio, Percentage of Faculty in National Academy of Engineering, Acceptance Rate, and Median GRE Scores.

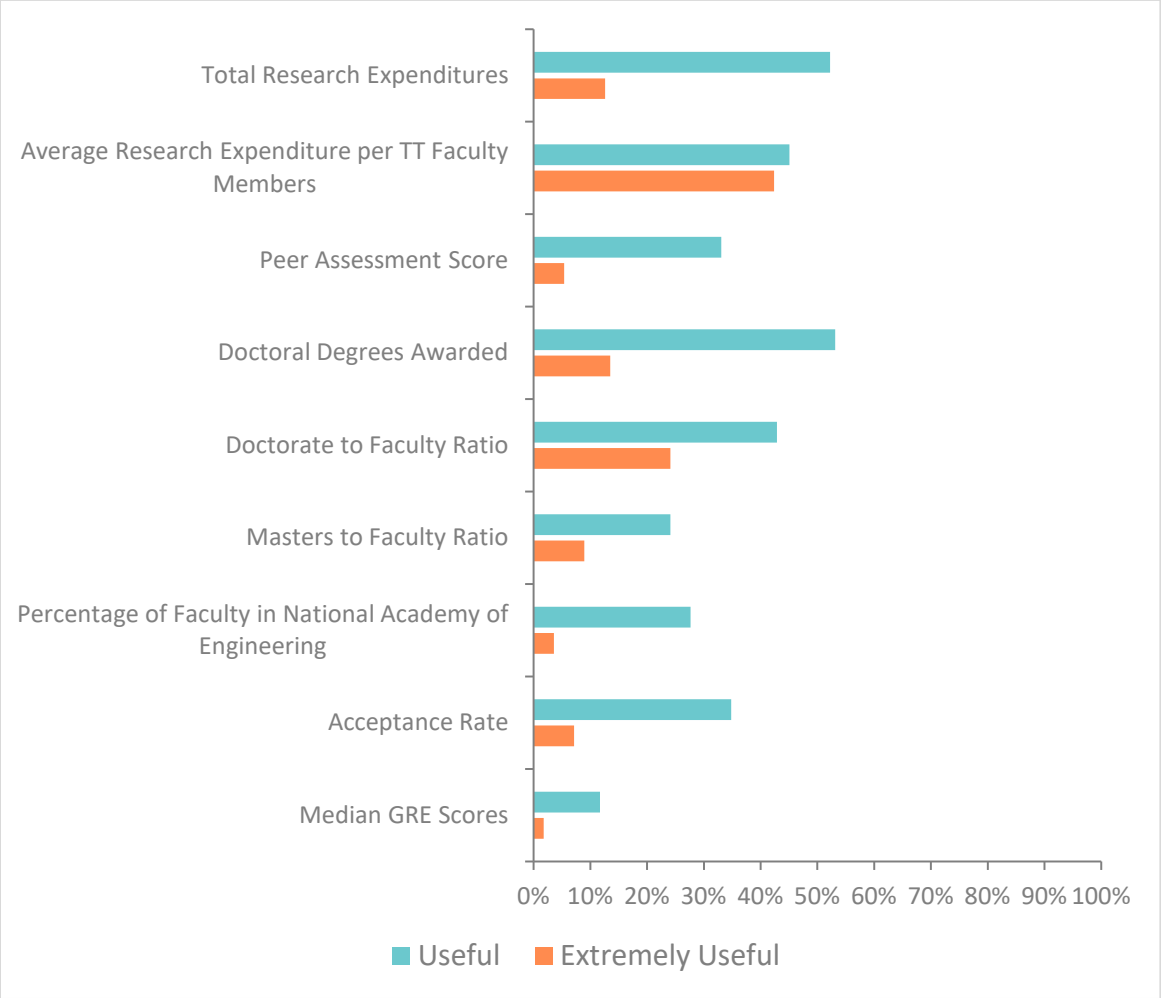


*Figure 3: For each variable below, how useful is this variable in ranking an institutions graduate engineering program?*

Figure 4 shows the negative responses for the same variables with options ranging from 'Not Useful' to 'Extremely Not Useful'. It is clear from the second chart that certain variables such as Median GRE Scores and Acceptance Rate are considered less useful by a substantial number of respondents, while the Percentage of Faculty in National Academy of Engineering, Doctorate to Faculty Ratio, and Doctoral Degrees Awarded are seen as more useful by comparison.

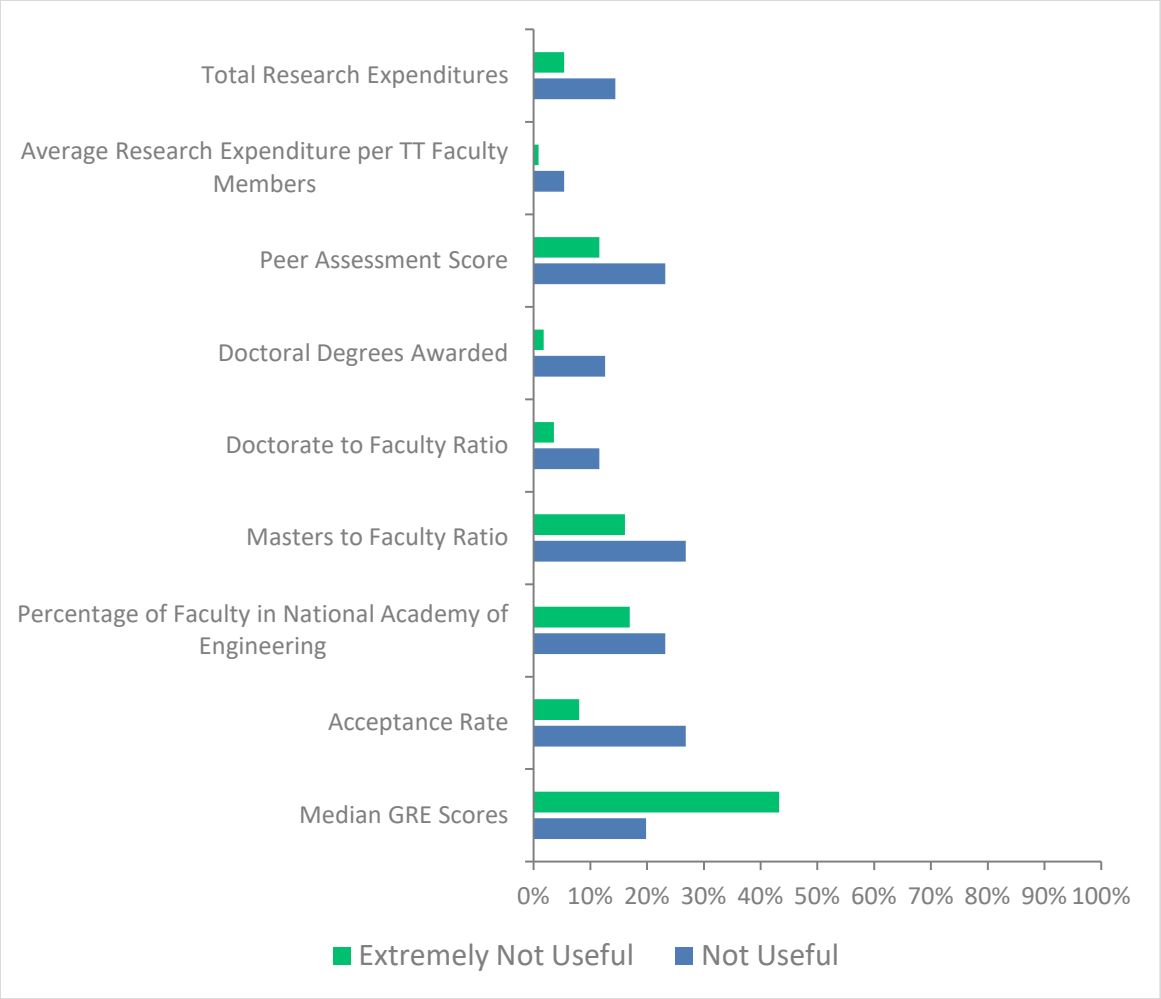


*Figure 4: For each variable below, how useful is this variable in ranking an institutions graduate engineering program?*

In combining the insights from both figures, one can conclude that variables related to faculty quality and output, like the Peer Assessment Score and the number of Doctoral Degrees Awarded, are generally seen as more useful for ranking purposes. In contrast, admissions statistics such as Median GRE Scores and Acceptance Rate are viewed as less indicative of a graduate engineering program's quality.

The comments collected about the US News & World Report's ranking methodology for engineering graduate programs express a variety of concerns and suggestions for improvement for each variable included.

Peer Assessment: Many respondents feel that the Peer Assessment metric rewards historical reputation rather than reflecting the current environment. It is viewed as an opinion-based measure that doesn't accurately assess the present quality of programs.

National Academy of Engineering (NAE) Membership: There's a suggestion to expand the consideration of academy memberships to include the National Academy of Sciences

and the National Academy of Medicine, providing a broader view of faculty achievements. There is a concern by some that the number of National Academy of Engineering members may not be a good indicator of program quality, and they suggest that only current members can nominate new members, which could perpetuate biases.

Acceptance Rate: Some believe that the acceptance rate should only consider doctoral programs, as including master's applications can penalize institutions with large master's offerings.

GRE Scores: There is a consensus that GRE scores do not predict program success and should not be used as a metric.

Research Expenditures: There's a significant concern about the emphasis on total research expenditures, as it tends to favor larger schools with more faculty and may not be an accurate measure of program quality or productivity. The reporting guidelines for research expenditures are seen as unclear, leading to inconsistencies in reporting among universities. Some suggest focusing on research expenditures related to graduate student research assistant stipends as a more relevant measure.

Faculty-Related Metrics: The use of tenure-track faculty in calculations is debated, with some feeling it overlooks the contribution of research professors who are not tenure-track. Metrics related to faculty, like the percentage of NAE members, are criticized for potentially incentivizing schools to 'buy' memberships, which may not reflect true program quality.

Intellectual Property and Publications: Respondents suggest including metrics for intellectual property outcomes and prestigious publication outcomes to reflect research impact and innovation.

Recruiter Assessment: The recruiter assessment score is seen by some as valuable, while others question its relevance to graduate program quality.

Definitions and Auditing: There are calls for stricter definitions and auditing of metrics, especially research expenditures, to prevent the skewing of results by institutions with affiliated research centers or those counting non-relevant expenditures.

Finally, a degree completion rate is suggested as a potentially more useful metric than acceptance rate or doctoral degrees awarded, as it might better reflect the outcomes of the program (however, see the next section).

## What should be included but isn’t currently?

Finally, we asked respondents about what is not included, but should be included in the US News and World Report ranking of engineering graduate programs. The two figures below display survey responses regarding which variables should be included in the ranking of engineering graduate programs.

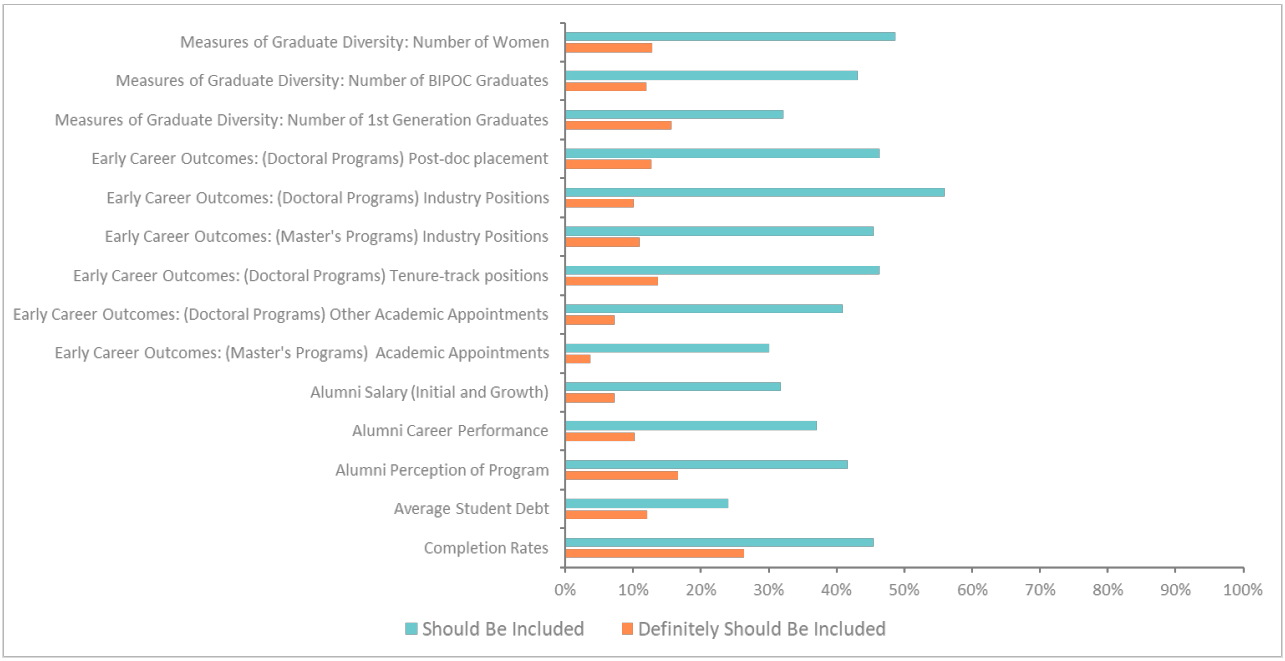


*Figure 5: What isn't included but should be in the rankings of engineering graduate programs?*

In Figure 5, the variable with the highest consensus for inclusion is 'Measures of Graduate Diversity: Number of Women', followed closely by 'Measures of Graduate Diversity: Number of BIPOC Graduates' and 'Measures of Graduate Diversity: Number of 1st Generation Graduates'. These diversity measures clearly hold significant importance among the respondents. 'Early Career Outcomes' for both Doctoral and Master's Programs across various categories like post-doc placement, industry positions, tenure-track positions, other academic appointments, and academic appointments also show a strong inclination towards being included, with the majority favoring their inclusion. 'Alumni Salary (Initial and Growth)', 'Alumni Career Performance', and 'Alumni Perception of Program' are also rated as important, with a notable number of respondents suggesting they should be included in rankings.

Figure 6 indicates variables that respondents feel 'Should Not Be Included' or 'Definitely Should Not Be Included'. 'Completion Rates' seem to be the least favored for inclusion, followed by 'Average Student Debt', indicating a perspective that these may not reflect the quality of engineering graduate programs as accurately as other metrics.

The responses reveal a clear preference for variables related to graduate diversity and early career outcomes to be considered in ranking engineering graduate programs, while there is a resistance towards including completion rates and average student debt as influential factors.

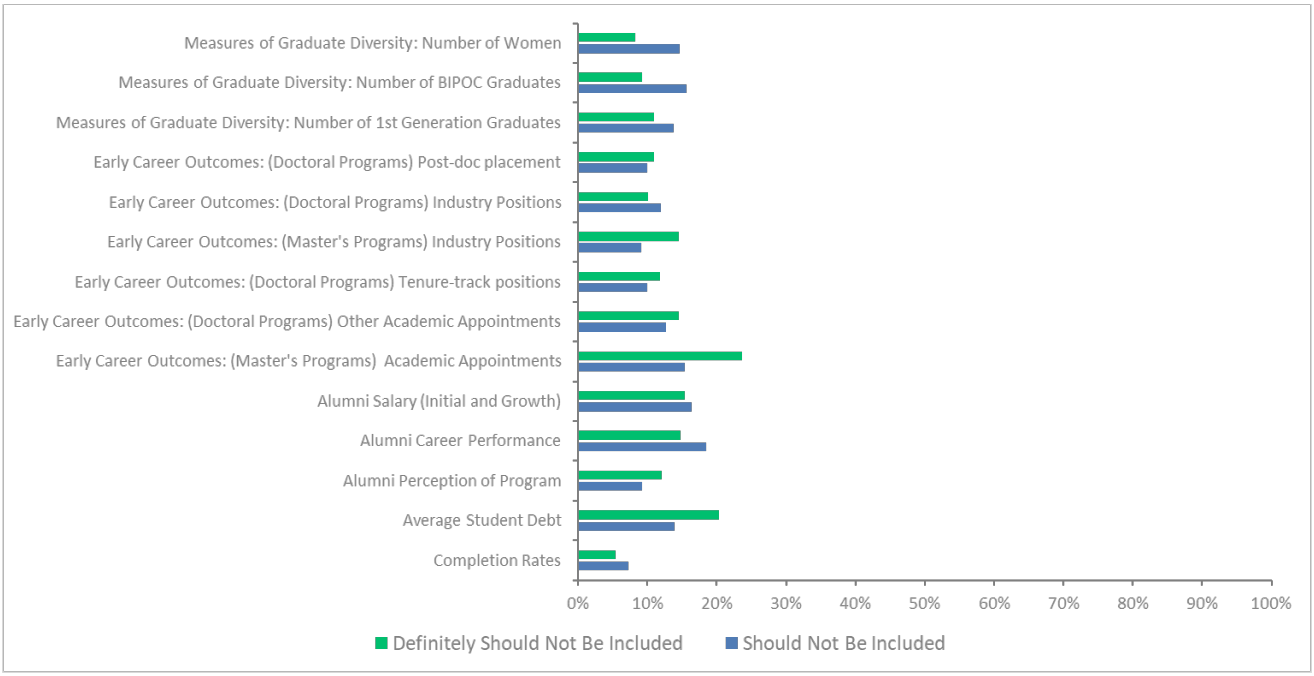


*Figure 6: What isn't included but should be in the rankings of engineering graduate programs?*

The comments suggest several areas for potential improvement in the ranking of engineering graduate programs, focusing on outcomes, diversity, and data normalization.

**Outcomes:**

- There's a strong interest in including early career outcomes, specifically the fraction of PhD graduates with jobs at graduation time, without placing undue emphasis on academic placements over industry roles.
- Career outcomes, including job placements and student satisfaction with achieving their goals post-graduation, are seen as valuable but challenging to collect and verify.
- Some respondents suggest that placement rates and career outcomes should be included without distinguishing between post-doc, industry, and academic positions, reflecting the diverse goals of students.

**Diversity:**

- Diversity metrics should be normalized as a percentage of the student population to avoid bias towards larger universities. However, there's a sentiment that these measures, while important, may not directly reflect the academic quality of programs.
- Demographics at the graduate level are complex, with the balance between continuing education and industry positions influencing the diversity of advanced degree programs.

- The percentage of women and BIPOC students and faculty, retention, and completion rates for these groups are mentioned as potentially insightful metrics.

**Data Normalization and Collection Challenges:**

- There is a concern that metrics based on volume (like the number of graduates) do not accurately reflect program quality and that percentage-based measures would be better.
- Collecting and reporting data on alumni success, including salaries, is seen as problematic due to its variability by region and discipline, and it may not reflect the true value of entrepreneurship or overseas employment.
- Tracking alumni outcomes is recognized as important but difficult to implement due to the challenges of maintaining contact with graduates.

**Additional Metrics:**

- The inclusion of metrics related to intellectual property outcomes, such as the number of faculty getting patents, is suggested.
- Time to degree, the percentage of students on assistantships or fellowships, and the average financial value of these supports are proposed as additional metrics.
- Measures of student debt and default rates are considered less relevant as they may not correlate with the quality of the program.

Overall, the comments reflect a desire for rankings to include metrics that provide a more holistic and nuanced picture of graduate program quality, considering both the outcomes for graduates and the diversity and inclusivity of the programs. However, there's also a recognition of the practical difficulties in collecting and standardizing such data across institutions.

## Conclusion

The findings from the survey indicate a diversity of perspectives among academic leaders on the current methodologies used for ranking engineering graduate programs. The feedback suggests consideration for a broader range of metrics, acknowledging both the potential value and the challenges associated with their collection and application. While there is an identified interest in metrics that encompass diversity and early career outcomes, the practicality of implementing these measures remains a subject of discussion. The survey results do not necessarily endorse a particular direction but rather illuminate the complex factors that engineering leaders want reflected in how engineering graduate programs are ranked.