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## **AC 2012-3690: FACULTY HIRING PATTERNS IN MECHANICAL ENGINEERING AT ELITE UNIVERSITIES**

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# Faculty Hiring Patterns in Mechanical Engineering at Elite Universities

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## Abstract

Does it matter where you do your doctorate if your goal is to become a faculty member at a top mechanical engineering research university? A number of criteria have been used to rank engineering institutions including total research and development expenditures, federally sponsored research and development, number of members of the National Academies, significant faculty awards, size of endowment and annual giving, and mean GRE scores of enrolling graduates students, among others. As per the *U.S. News and World Report* rankings, the top 10 ranked programs in Mechanical Engineering are MIT, Stanford, UC-Berkeley, CalTech, Michigan-Ann Arbor, Georgia Tech, Illinois-Urbana Champagne, Cornell, Purdue and Princeton. However, as a graduating mechanical engineering doctoral student, what are your chances of receiving an offer at one of these top-ranked institutions in Mechanical Engineering. This study looks at the distribution of faculty at these institutions and where they received their doctorate. More than 60% of the faculty at the 10 top-ranked institutions has received their doctorate from these institutions themselves with nearly 45% of them from the top four. If you include other Ivy League schools and major international universities such as the University of Cambridge, this number increases to nearly 80%. More than 50% of MIT faculty has received their doctorate from MIT itself. Georgia Tech is the most diverse and had the highest percent of faculty from non top 10 ranked institutions. MIT, Caltech and Stanford are the only institutions to have successfully placed their graduates at each of the top 10 ranked institutions, while UC-Berkeley takes the top honors in placing the highest number of its graduates at other top ranked institutions. So it appears that the institution where graduates receive their doctorate affects their employability as a faculty member at the top 10 ranked mechanical engineering programs.

## Background

“The common wisdom is that you'll never secure a position at a university that is higher ranked than your PhD program. While there are notable exceptions, this tends to hold true for most people, across all disciplines.”

“In my field, most professors at top-10 schools also got their degrees at top-10 schools.”<sup>1</sup>

These are some of the statements on the web in response to the question “Does it matter where you get your PhD?” In 2005, Wu collected degree information for over 5,000 full-time faculties in six disciplines (chemistry, economics, English, history, mathematics, and sociology) who were employed at liberal arts colleges and universities ranked as the top 25 in the *U.S. News and World Report* rankings<sup>2</sup>. He cross tabulated information for these faculty members to determine who among them had obtained their PhDs from departments that were ranked among the top 10 and 20 programs in the *U.S. News* rankings for each discipline.

While the *U.S. News* rankings are often maligned for the subjectivity of their quality ratings, Wu's findings do suggest some underlying validity in the ratings, at least as a predictor for academic employment. Over 67% of faculty employed in Economics departments of top-rated "national universities" had degrees from the top 10 schools, as compared to approximately 59% in History and 57% in English departments<sup>2</sup>.

Townsend expanded the analysis for History, looking beyond the top 25 programs to a much wider range of departments employing history PhDs, while also including faculty who are not employed full time. He found that faculty employed in the top quartile of programs conferring history PhDs in the *U.S. News* rankings, were a relatively closed circuit of PhDs and employment. Almost 80% of the full-time faculty listed at those programs received their degrees from either the same program or another program in the same tier of the rankings.

The dominance of PhDs from the top-tier schools diminishes sharply when one looks at history departments that do not confer a history PhD. Only 44% of full-time faculty at these departments earned PhDs from a top-tier institution, while 33% earned their degrees from one of the other domestic programs, and 12% earned their degrees overseas<sup>3</sup>.

There is a perception that similar hiring patterns exist in engineering disciplines. Currently there is not enough research data available to substantially validate this claim. In addition there is a ‘myth’ that PhDs are not hired at the institutions where they received their PhD. This paper attempts to quantify the hiring pattern in the field of Mechanical Engineering at the top 10 Mechanical Engineering research programs in the United States.

This is important as people who have trained at great length and expense to be researchers confront a swindling number of academic jobs<sup>4</sup>. In 1974, fewer than 30% of all science and engineering (S&E) Ph.D.s were working in industry, and more than 45% were in tenure-track faculty positions. By 1999, the trend had reversed with nearly 38% S&E Ph.D.s who had received their training in the United States were working in industry, whereas about 25% were working in a tenure-track position in academe<sup>5</sup>.

## **Methodology**

Colleges and universities now customarily provide information about their faculties on their websites, including details such as year of hiring, dates and institutions where degrees were earned, and research specialties. The information for this article was obtained from the websites of the top 10 research universities in mechanical engineering during Fall 2010, as determined by

the *U.S. News and World Report* rankings for 2010. This paper includes data only for faculty members holding permanent positions at the rank of assistant, associate, or full professor. Information about individuals holding temporary and adjunct positions, emeriti faculty, and individuals whose doctoral school could not be identified were excluded from the analysis. The resulting data set includes information for around four hundred and sixty six (N=466) faculty members at these universities.

This paper looks at the 2010 *U.S. News* rating of the top 10 mechanical engineering programs at research universities in the United States. Note that although the *U.S. News* rankings were used, there is a high correlation between different ranking schemes. Hence key results will likely not significantly differ had another ranking been used. The top 10 ranked programs in mechanical engineering used in this study are the Massachusetts Institute of Technology (MIT), Stanford University, the University of California at Berkeley (UC-Berkeley), the California Institute of Technology (CalTech), the University of Michigan at Ann Arbor (Michigan-Ann Arbor), the Georgia Institute of Technology (Georgia Tech), the University of Illinois at Urbana Champagne (UIUC), Cornell University, Purdue University, and Princeton University.

The number of doctorates in mechanical engineering awarded by all US academic institutions is around 1000 per year for the past five years<sup>6</sup>. Of these, the number of doctorates in mechanical engineering awarded by the top 10 mechanical engineering programs varied from about 10 per year at CalTech to about 50 per year at UC-Berkeley, MIT and Michigan-Ann Arbor for a total of about 35% of the number of doctorates in mechanical engineering awarded by all US academic institutions<sup>7</sup>.

## Results

Table 1 shows the institutions from which the faculty at the top 10 mechanical engineering research institutions obtained their doctorate. On average, 61% of the mechanical engineering faculty received their doctorates from one of the top 10 mechanical engineering research institutions. Approximately 70% of faculties (N=170) at private institutions have doctorates from top 10 schools, as compared to 55% (N=296) at public institutions.

However, if one includes other Ivy League schools and top international universities such as the University of Cambridge, 81% of the mechanical engineering faculty received their doctorates from one of the top 10 mechanical engineering research institutions, an Ivy League school, or a top international university. Ninety-five percent of faculties at private institutions and 73% of faculties at public institutions belong to this category.

Further analysis of the data shows that 45% (N=466) of all faculty and 72% (N=282) of those who received their doctorate at one of the top 10 research institution in the United States received their doctorate at one of the top four schools - MIT, Stanford, UC-Berkeley or CalTech. Georgia Tech is the most diverse institution with the highest percent of faculty from non top-ranked institutions.

Table 1 – Percentage of Faculty at Top 10 Mechanical Engineering Research Institutions with Doctorates from Top Graduate Programs

	Doctorates from Top 10 Schools + Ivy League Schools + International Universities	Doctorates from Top 10 Schools
MIT	94	76
Stanford	95	74
UC-Berkeley	87	58
CalTech	100	71
Michigan-Ann Arbor	90	72
Georgia Tech	61	46
UIUC	79	56
Cornell	100	71
Purdue	63	50
Princeton	92	46

Figure 1 shows the percentage of faculty at these top 10 institutions who received their doctorate from the same institution at which they are currently employed. The top four ranked schools - MIT, Stanford, UC-Berkeley and CalTech - are also the only schools which have more 25% of their faculty who have received doctorates from the same institution at which they are currently employed. MIT has the highest percentage of faculty, more than 50%, who have received their doctorate from the home institution (MIT in this case) itself.

Sixteen percent of all the faculty members at these top 10 mechanical engineering programs have received their doctorate from MIT, which produces about 5% of the number of doctorates in mechanical engineering awarded by all US academic institutions, and 13% have received their doctorate overseas. However, excluding the faculty who are employed at the institution at which they received their doctorate, UC-Berkeley was most successful in placing its graduates at the other top ranked institutions while MIT, Stanford and CalTech are the only schools which have successfully placed their graduates at each of the top 10 ranked institutions.

While the ‘myth’ that PhDs are not hired at the institutions where they received their PhDs might be true at smaller institutions; it does not appear to be true at the top ranked institutions.

So what do these finding mean for graduate schools and graduate students? As the fraction of doctorates employed in tenure track positions in academia continues to decline and become highly competitive, it might be more than ever important for graduate schools in general to redefine the PhD as also training for high-level positions in careers outside academia besides preparing them for an academic position.

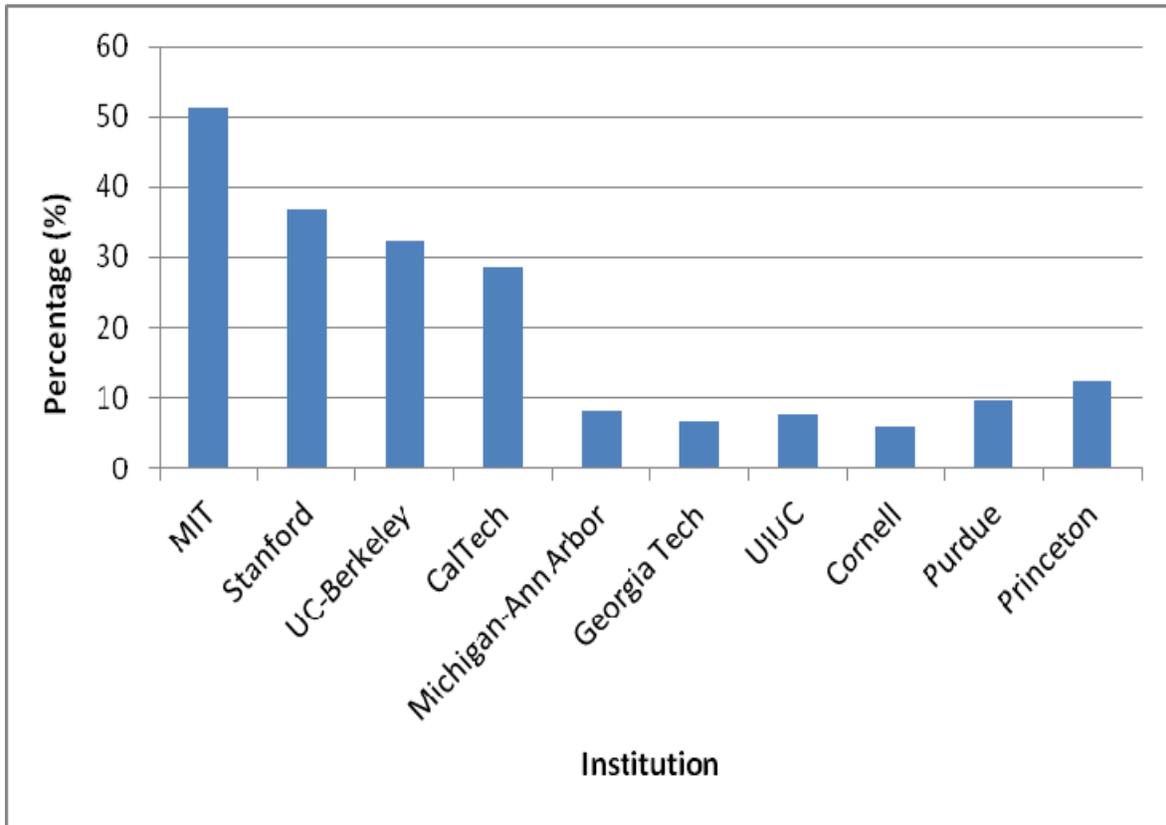


Figure 1 – Percentage of Faculty with Doctorate from the Home Institution

Traditionally, PhD programs place emphasis on providing teaching and research opportunities to students as preparation for academic careers.

For those that move into finding alternate non-academic careers, additional skill training may prove useful. Thus the program could focus on training of the mind, student development, graduate internships, structured required courses in entrepreneurship, global education and research, presentation, proposal and report writing and other transferable skills<sup>4</sup>.

It may be wise for PhD programs to combine with management programs and offer a joint PhD/MBA degrees so that graduates who may become technical leads at companies get not only depth in their area of expertise but also gain requisite management skills to lead groups.

Finally, while these results in general may apply to other engineering disciplines, this study has focused strictly on the mechanical engineering programs.

## Conclusions

This study looks at the distribution of faculty members at the top 10 ranked mechanical engineering programs and where they received their doctorate. More than 60% of faculty members at the 10 top-ranked institutions have received their doctorate from these institutions themselves, and that 45% of all faculty and 72% of those who received their doctorate at one of the top 10 research institution in the United States received their doctorate at one of the top four ranked schools. If one includes other Ivy League schools and major international universities, this number increases to nearly 80%. More than 50% of MIT faculty members have received their doctorate from MIT itself. Georgia Tech is the most diverse and has the highest percentage of faculty from non top-ranked institutions. MIT, Caltech and Stanford are the only institutions to have successfully placed their graduates at each of the top 10 ranked institutions, while UC-Berkeley takes the top honors in placing the highest number of its graduates at other top ranked institutions. Thus it appears that the institution where graduates receive their doctorate affects their employability as a faculty member at the top 10 ranked mechanical engineering programs.

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