An Analysis of Online Master's Programs in Engineering

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Abstract

Many schools are beginning to put graduate degrees, particularly Master's degrees, online. We could not locate any sources that analyzed the current state of online engineering graduate education. Thus, an analysis of 163 institutions that offer graduate degrees in engineering was conducted. The results shed light on the nature of the programs, the cost, degrees offered, and the institutions who are currently offering such programs.

Introduction

The Internet has emerged as a tool to facilitate distance education both in the United States and internationally. Before the broad adoption of the Internet, distance education was often implemented through satellite feeds or through regular postal mailing of videos. The Internet has enabled distance education to be both more efficient and effective [1-3]. In engineering education, the adoption rate of effective online educational strategies has been lower than in other disciplines[4]. The importance of laboratory and hands-on experiments, as well as ABET accreditation policies are likely to be part of the reason for this gap. But one part of engineering education has increased much more rapidly online: the Master's degree. Because the Master's degree is typically not accredited, colleges and universities have fewer restrictions to putting their graduate programs online. There is also a strong demand among engineering graduates who are working full time in engineering careers. These students have difficultly taking classes in traditional Master's and PhD programs and are attracted to online programs due to their flexibility. The demand of engineers looking for graduate education online has been met by universities eager to find more income streams. This demand, and the profit from it, is likely a major cause in the emergence of the online Master's degree.

In searching for information about online Master's and PhD programs in engineering, we found little except for the individual universities that offer these programs. A snapshot of the current state of online Master's and PhD programs would serve to demonstrate how fast these programs have grown in a short time. The information could also be useful to others who wish to further study the topic and online engineering education in general. And ultimately it is hoped that the success of the online graduate programs could serve as an example of how to implement online education at the undergraduate level as well. This study was conducted by exploring the US News and World Report school rankings and filtering the results to show only schools that offer some type of graduate program in engineering. This search yielded 198 schools that offer either a

Master's or PhD in engineering. Then each school's website was individually searched to determine whether or not they offered a graduate engineering degree online. We spent considerable time trying to locate these programs, often through multiple searches involving online and distance education. We also visited the engineering page of each school's website to further look for these types of programs. After the intensive search, we have found at least 54 colleges and universities who offer at least one graduate degree online. This represents 27% of all schools that offer graduate degrees in engineering. This is quite a remarkable growth that has occurred in a relatively short amount of time. While online undergraduate engineering education is mainly relegated to individual courses and hybrid/blended formats, one can obtain an engineering Master's degree in nearly every discipline.

Results

Our analysis revealed a total of 163 Master's degrees that are offered at the 54 institutions that offered engineering graduate degrees online. This averages to about 3 degrees per institution. North Carolina State offered the most engineering Master's degrees online with 12. Figure 1 shows percentage of master's programs surveyed by discipline while Figure 2 shows the percentage of students enrolled in undergraduate engineering in the United States for the same disciplines[5]. The largest difference is in the Industrial Engineering and Engineering Management Category. This represents only 4% of undergraduate students but 28% of the online Master's programs. This is not entirely surprising since many engineers who work fulltime in

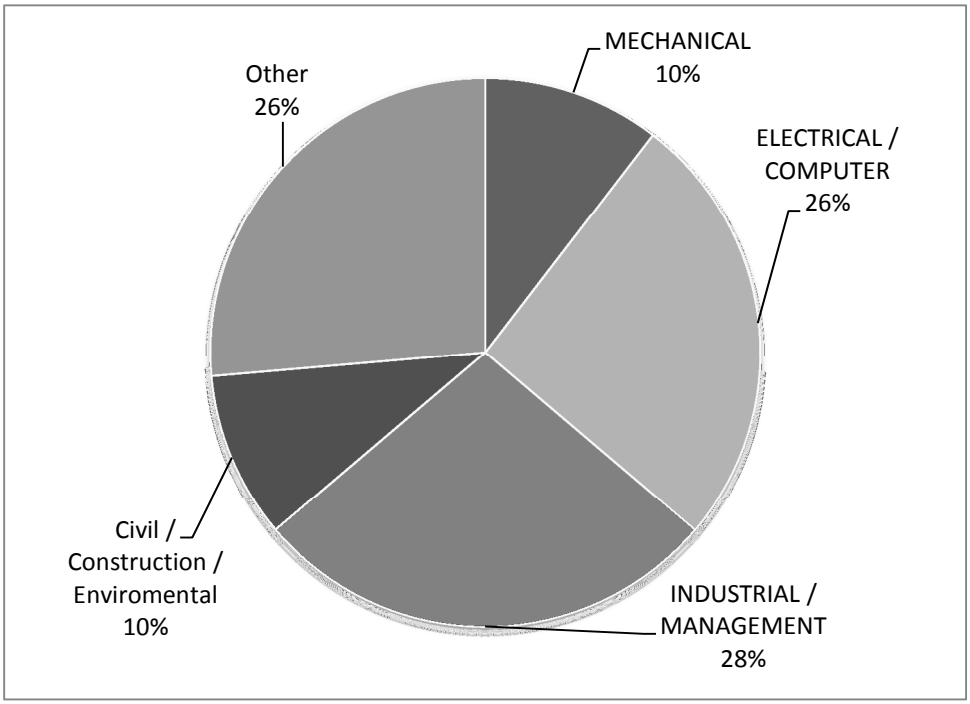

Figure 1: Percentage of engineering master's programs offered online by discipline. Total = 163.

industry choose this type of program for their graduate education. It is also a program that can more easily be put online. The largest drop between undergraduate enrollment and online Master's programs was in mechanical engineering. Perhaps the technical and experimental nature of many of these programs made the online transition more difficult. This gap does suggest there may be a market for online mechanical engineering programs.

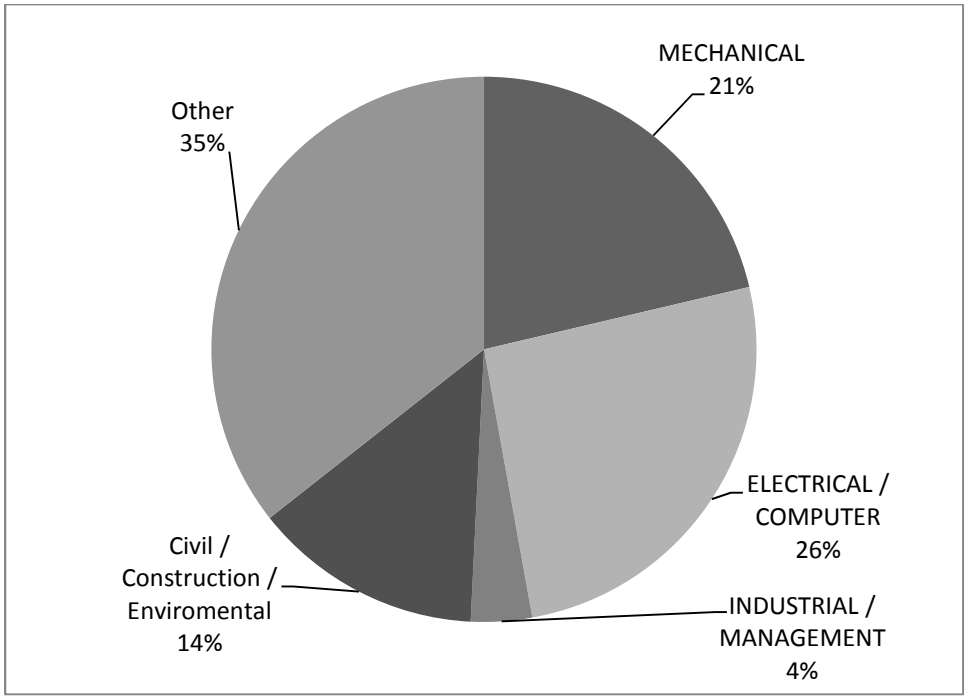

Figure 2: Percentage of engineering undergraduate students by discipline. Total = 385,690. Source: American Society for Engineering Education.

The other category consisted of chemical engineering, aerospace engineering, biomedical engineering, biological engineering, materials engineering, petroleum engineering, nuclear engineering, and general or interdisciplinary engineering. None of these categories were greater than 8% of either total. Figure 3 shows the distribution of institutions online Master's programs by state. This information is useful for individuals looking to find specific programs within their state. Since most institutions charge more for out-of-state residents, it is important to consider what options are available in state. While the online Master's degree is available in many parts of the country, there appears to be a slightly higher concentration in the Midwest and Northeast. The tuition costs of each of these programs were also tracked. The cost per credit hour varied from a low of $154 to a high of $2630. The median cost was $623 per credit hour for instate students and $1067 per credit hour for out of state students. Compared to an average of $253 per credit hour for instate undergraduate tuition[6], the cost of these online programs likely yields significant profit margin for their institutions. Table 1 contains a list of all institutions that offered graduate engineering degrees online that were included in this study. Most schools required about 30 hours for the Master's degree and about a third of the schools offered both thesis and non-thesis options. The other schools offered only a non-thesis option.

Our study of online engineering graduate programs only yielded six PhD programs offered online. Four of these programs are offered at Mississippi State University, with two others at Michigan Tech and the Naval Postgraduate School. While other programs may exist, there appears to be a much smaller amount of offerings of online engineering PhD programs. Two of the six programs were in Electrical/Computer Engineering or Computer Science. The other programs were in mechanical engineering, industrial engineering, civil engineering, and systems engineering.

Figure 3: Distribution of online engineering Master's programs by state. The number represents the number of institutions that offer an engineering Master's degree online.

Conclusion

Online engineering graduate education has emerged quickly in recent years. Many prestigious schools have begun to offer an online Master's degree. There is significant demand from industry and many programs are priced well above traditional classroom rates. The emergence of the online Master's degree may foreshadow further usage of the Internet in undergraduate education. Industrial engineering and engineering management programs are far more

represented, as a proportion of total programs, in online graduate education than in undergraduate education. The number of schools offering an engineering PhD online is still relatively low.

Table 1: List of schools that offer engineering graduate degrees online.

Arizona State University	Stevens Institute of Technology
Auburn University	Texas A & M University
Binghamton University	Texas Tech University
Boston University	University of Alaska-Fairbanks
Clemson University	University of Alabama-Huntsville
Columbia University	University of Arkansas-Fayetteville
Drexel University	University of California-Los Angeles
Illinois Institute of Technology	University of Colorado-Colorado Springs
Iowa State University	University of Delaware
Lawrence Tech	University of Idaho
Lehigh University	University of Illinois-Chicago
Louisiana Tech University	University of Illinois-Urbana-Champaign
Michigan Tech University	University of Maine
Mississippi State University	University of Michigan
Missouri University of Science & Tech	University of Minnesota
Naval Post Graduate School	University of Nebraska-Lincoln
New Jersey Institute of Technology	University of New Mexico
New Mexico Tech University	University of South Florida
New Mexico State University	University of Southern California
North Carolina State University	University of Tennessee-Knoxville
North Dakota State University	University of Texas - Arlington
Ohio University	University of Washington
Oklahoma State University	University of Wisconsin-Madison
Old Dominion University	Virginia Tech University
Purdue University	Washington State University
Rensselaer Polytechnic Institute	West Virginia University
Stanford University	Worcester Polytechnic Institute

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Biographical Information

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Michael Reynolds is an Associate Professor and Head of Engineering at the University of Arkansas – Fort Smith. Michael earned his PhD in Mechanical Engineering at Purdue University in 2004. Michael's research interests include control systems, vibration, and engineering education. Michael is the Editor-in-Chief of the Journal of Online Engineering Education.

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