Philip A. Voglewede, BSME 1994.

During my last semester at ND (Spring of 1994), I applied to several schools (Georgia Tech, Stanford, Cal Tech, Cal-Berkeley, ND) as well as numerous companies (GM, Ford, Whirlpool) and was pretty well set on going to graduate school. However, I received a wonderful offer from Whirlpool, and decided that I would go to work to pay off my large debt and get away from the academic grind for a while. I worked for 6 years at Whirlpool during which time they sent me to the University of Michigan to get my masters degree. I really enjoyed my time at Whirlpool, but felt that I would really love the academic environment. In the fall of 2000, I matriculated at Georgia Tech to pursue my PhD. After graduating in the spring of 2004, I started at the University of South Carolina where I teach and research robotics, controls, and numerical methods.

Looking back, I would not do it any other way. For my personal development, I needed time away from the academic environment to regroup and figure out what I truly wanted to do. However, there are pros and cons to the approach I did. For every year I was out, it was harder to go back to graduate school. My math skills degraded each year I was out. Earning under half of what I did previously during my time at Georgia Tech was also hard to swallow. However, I did have a better perspective on grades and how the coursework integrated into real life situations.

As I see the situation, for an engineer to move up in industry or in academic world, an advanced degree of some sort is highly desirable. If financial reward is what is desired, then I would even suggest an MBA after one has worked for a while. However, this doesn't mean that one needs to go to graduate school to be successful. Life is full of successful persons who have not gotten advanced degrees. But there is something to be said of persons that have the knowledge and desire to continue their education. Whether that has to be right after graduation or not is immaterial. That can be completed whenever one is ready, as long as he or she is willing.

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I came to Notre Dame thinking that I would get my mechanical engineering degree and get a job. My father was an engineer who had gotten an MBA after working for several years, and that seemed like a good way to go. Two things changed my mind during my senior year. 1) I realized that I really enjoyed mechanical engineering, and 2) I saw that the engineers with only bachelor's degree at my internship employer never got to do any real engineering, at least not anything that I would have considered interesting. I wanted to directly use the engineering knowledge I had worked very hard for four years to gain, so I decided to get my Master's degree in ME to open up more technical career opportunities for myself. Plus, I knew that a Master's would mean a higher salary once I did start working. I interviewed with a couple of companies offering programs that paid for a Master's while you worked. Ultimately, I did not pursue this option because the universities involved were not highly respected, which I thought would limit my credibility if I decided to change companies. I wanted to keep my options open. I started my graduate program at Ohio State thinking that I would get my Master's and get a job. After a year and a half, I had my Master's, but realized that I liked the technical challenge of the work too much. Unlike my friends who were already working in industry, I wanted the freedom to choose the types of projects on which I would work. I figured I could always quit the Ph.D. program and get a job if I didn't like it. Again, I wanted to keep my options open. It turned out that I did enjoy it, and after graduating in 2001, I got a job as an assistant professor at the University of Iowa. I've since moved back to Ohio State as an assistant professor, and I love what I do. I teach the classes that were my favorites as an undergrad, and I build walking robots with my graduate students in my research lab. I choose the projects, and I have the pleasure of working with and around a lot of extremely bright people. For me, graduate work in engineering turned out to be the right decision because it has provided me with the opportunity to get up in the morning every day and go to a job that is both challenging and fun.

John-David Yoder <j-yoder@onu.edu>
I chose to go directly to graduate school after I finished my undergrad at ND in 1991. For me, that was the right decision. It worked well for my family situation (I got married in 1991 and my wife also wanted to go to graduate school), and I was able to obtain a fellowship. The first thing to realize is that, in engineering, you can be almost assured that you will be paid for going to graduate school, rather than continuing to pay tuition. It is not a lot of money, but it is enough to get by on.

I went to graduate school with a mix of people -- some had been out of school for some time, others were like me, coming straight from undergrad. In general, those coming straight from school had an advantage in the academic side of things, since the coursework was far fresher in our minds. It would have been much more difficult for me to come back after years in industry and jump right back into the level of mathematics that we were expected to be able to do. The other advantage that we had was less responsibility -- without a family and a mortgage, it was pretty easy to live off of the fellowship money.

There are also advantages to going back to graduate school at a later time. Some of my fellow students were being sent to graduate school by their employer, meaning they still drew a portion of the salary, still had benefits, and had a job to go back to after grad school. Also, people who had been in industry for some time tended to have more focus about precisely what area they wanted to study.

While I was in graduate school, I started a small company. I worked fulltime for that company for several years after graduate school, and still do some work with that today. I have also worked for an international engineering company, and currently am teaching. The first two jobs really did not require a PhD, but my current one certainly does. Feel free to contact me if you have questions.

JD Yoder
'91, '94, '96

Background

My name is Nicholas Glassmaker, and I graduated with B.S. in mechanical engineering at Notre Dame in 2000. I completed a Ph.D. in Theoretical and Applied Mechanics at Cornell University in 2004. Currently, I am working in a post-doctoral research position in a small research group at Lehigh University that includes professors, other "post-docs," graduate students, and undergraduate students. mailto:nglassma@gmail.com

What is graduate school?

Since I had little idea what happens in graduate school before seriously considering it, let me begin by stating a few of my ideas about what graduate school is. Graduate school is not all that similar to undergraduate study. The curriculum, expectations, and student and faculty relationships are all significantly different. First, the curriculum: Usually, both master's and Ph.D. degrees begin with a series of advanced courses. While most of these are extensions of undergraduate material, or in fact, advanced undergraduate courses, others are very specialized. In mechanical engineering, the courses typically consist of an advanced math curriculum, as well as advanced dynamics, and fluid/solid mechanics. My experience was that graduate courses tend to emphasize mathematics and Newtonian physics rather than design. Often, deriving and solving the suitable equations is of more interest than applying a known result (i.e. as a formula). I felt that ND prepared me very well for all the courses I took in graduate school.

However, graduate study is not just a series of advanced courses (except in a few terminal master's programs). Nearly every master's degree and all Ph.D. degrees will require some element of original research. After one or two years, the course workload is greatly reduced or removed altogether, and the student works on a research project. During this period, the student works primarily under the supervision of one faculty advisor.

The student's progression through a program is marked by a series of exams. For a Ph.D., this usually begins with a 'qualifying' exam, which tests the student's knowledge of undergraduate and first-year graduate coursework. The qualifying exam may be oral or written, or a combination. When the student is ready to begin research work, another exam often called the 'admission to candidacy' exam is administered. This usually includes a presentation of a preliminary research problem the student has worked on with his/her advisor. The candidacy exam may include questions about advanced coursework, or just about anything related to the proposed research track. It is usually completely oral. Finally, when Ph.D. work is finished, the student must orally defend his/her dissertation in front of a committee of faculty members. (This committee is chosen by the student for advising purposes during the period s/he is working on the dissertation research.) Once approved by the committee, the written dissertation is finally submitted to the graduate school for archiving.

Why should I go to graduate school?

If you want to become a professor of mechanical engineering, a Ph.D. is a requirement. Outside of academia, those with a graduate education have some distinct advantages (and a few disadvantages) compared with those who have only a bachelor's degree in

mechanical engineering. First of all, those who wish to take on leadership roles in engineering tend to have a master's or Ph.D. in engineering or an MBA. In industrial research, as well as national laboratories, the Ph.D. degree is preferred for leaders and those who are individually responsible for a given research initiative. Graduate education gives one a great advantage when seeking employment in research. In manufacturing, design, and engineering management, a graduate degree is also advantageous, but not usually as much as in research and academic positions.

Besides positioning one for a particular type of position, a graduate degree will increase understanding beyond the undergraduate level, which is probably obvious. This tends to make the tasks one will encounter in a future career more challenging, and often on the cutting edge of what is known in a given field or application. Most find this more interesting and engaging than a bachelor's level career. Certainly it will pay better! (See next section.) However, there is a slight disadvantage to a graduate degree in engineering. One is a bit limited in the types of jobs one can obtain, since those with graduate degrees are not usually considered for undergraduate level positions. Usually, the jobs that are eliminated are not of interest to those with the graduate degree, but not always. Also, this might cause difficulties in times of low job availability, or if one desires to live in a certain part of the country (there may not be any non-bachelor's level jobs in certain areas).

Bottom line: Is graduate school financially sensible?

This is obviously a question that can only be answered individually, but there are a couple of key facts that one should consider.

Fact #1: For those pursuing Ph.D. degrees, graduate school is F-R-E-E free! Tuition is paid by the department accepting the student. The student is responsible for living expenses, such as room and board, transportation, books, etc. However,

Fact #2: All major graduate institutions PAY their students a stipend. The stipend is not enough for anything close to luxurious living, but is usually adequate for living expenses. One may be required to serve as a teaching assistant to receive a stipend, but this is not always the case. Many graduate students in engineering are paid as research assistants, that is, to perform research that will ultimately be used by the student to write a dissertation. In addition to a stipend, many competitive graduate schools provide partially or fully subsidized health insurance.

Now, in spite of receiving a stipend, one could argue that a B.S. level job in industry would pay 2-3 times as much. However, upon graduation, M.S. and Ph.D. credentials tend to earn about 150-200% more than B.S. level mech. engineers. Since graduate school lasts only about 5 years for a Ph.D., the increase in salary level will more than compensate for the lost time after several years.

Regarding terminal master's degrees: these are not always free tuition, and students in these programs are not always given stipends either. Study the program carefully.

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I'm always wary of those who try to sell me something too hard, but I have to say that going to grad school was one of the best choices I've made. I was lucky enough to be accepted into some great programs and had the opportunity to choose a school where I completely fit in socially and professionally. Also, I've had some awesome opportunities that I wouldn't have had if I had gone into industry. This past summer, I applied for and won a fellowship that paid for me to do research in Australia for eight weeks. I was able to make a contact down under that I might use to find a post-doc position when I finish my degree.

Moreover, it's great to still be a student. Once you get past the classes (which are usually fewer than you expect), you have what is basically a full-time job in a college environment. It is different and tougher than anything you've been exposed to yet, but you're in it with a group of people who are experiencing the same thing. I admit, it's not for everyone, but if you've ever been a little bit proud of an all-nighter working on Senior Design or one of Howland's programming projects, it might be.
Something else: professors are such a separate entity while in undergrad that it's difficult to understand the new relationship you obtain by going to grad school. Going out for a beer at the bar across the street after a long day in lab really does happen. It may not be enticing to some, but the types of professors who want to buy everyone a round usually have the best stories to tell.

So add this to the fact that doing research, while it can be the most frustrating work of your career, can also be the most rewarding. You own your research and start to become an 'authority' on the subject. I know there are similar opportunities in industry, but it's not so much part of the definition as it is when you choose to be an academic.

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During my freshman and sophomore years of college, I was adamant about starting a job directly after graduation as a mechanical engineer. But, during my junior year I started to realize that I actually enjoyed the more difficult homework and research/design projects. It was suggested that I look into graduate school. By senior year I had visited and applied to several graduate schools. After graduating with a B.S. in M.E. in 1991, I attended the University of Illinois in the department of Theoretical and Applied Mechanics. I first found the graduate classes to be very challenging, and at times thought I would not make it through. But, by the second year of graduate school, I started to have success with the coursework, and started my research project. It is amazing how fast one can reach the envelope of knowledge, and start making contributions. Since graduation (M.S. 1993, PhD 1996), I have worked at Los Alamos National Laboratory, and met many of the founders of scientific fields I studied in graduate school. It has, and continues to be, an exciting career choice.

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Healthcare presents an enormous opportunity for engineers and scientists to apply their knowledge and skills for the betterment of society. The problems to be solved are complex and multidisciplinary. It takes teams of dedicated and highly educated PhDs and MDs to solve these problems. A graduate degree in science and engineering offers the opportunity to be part of the innovation explosion in medicine. Thanks to obtaining a PhD, I have been able to develop a diverse number of products from infant hearing screeners (Natus Medical Inc.) to inflammation monitoring for asthmatics (Aperon Biosystems Inc.) to advanced hearing aids (EarLens Corporation). In addition, a graduate degree provides the credential needed to lead the research and engineering development. People that enjoy being creative, solving problems, and bringing ideas to life in the real world, should seriously consider engineering or scientific graduate school. Developing an idea sketched on a whiteboard into a technology that improves the health of others is a wonderfully fulfilling and rewarding process.

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My decision to go to engineering graduate school after graduation from ND was based on my desire to be involved in technical innovation. I always enjoyed solving new and challenging technical problems and was also motivated by the market opportunites that solutions to these problems can bring. At the time, I never anticipated that I would choose an academic career path. That came about not so much because of a change in my likes and dislikes, but more because of an intensifcation of them. I realized that as a researcher, everyday brings new challenge and opportunity. Because of this I never dread going to work. In fact, I can never seem to get enough time to tackle all of the problems that I am interested in. I consider myself very lucky to be doing work that I truly love.