

Should I Consider Graduate School?

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An important decision for young professionals, either just emerging with their first degree, or having spent a few years in industry, is whether to attend graduate school. Our industry increasingly relies on advanced technology. Top management positions at many companies are held by technical professionals with advanced degrees. Here is some advice on how to decide for yourself about graduate education.

First, some definitions. In the Netherlands, where I now teach, an MSc is usually considered the first professional degree. One isn't expected to leave university at the bachelors degree, which in turn doesn't prepare one for a career; that is left for the MSc. "Graduate school" here means PhD studies. In the U.S., where I taught before, by far most students start their careers with a BS degree. There, "graduate school" includes MS as well as PhD studies. In this essay, by "graduate school" I mean studies beyond the first professional degree, whatever that means in your country.

There are several good reasons to attend graduate school. Here are a few of them:

Preparing for a career focusing on technology - Graduate studies give you increased grounding in the fundamentals of your discipline and usually (in a thesis or dissertation) experience in conducting open-ended research. This prepares you for a career in technology-development and research. In most large companies these jobs are held almost exclusively by people with MS or PhD degrees, especially PhD degrees. I can think of two people I have known over 30 years who made careers in research and development with a BS degree; one of them started his own company, where he got to set the personnel policies. For the most part, if you want to have a career in research and development, you should get a graduate degree.

This isn't simply a matter of getting a credential. In preparing to write this essay, I listed basic analytical tools I learned in graduate school. In 15 minutes I came up with about 20 fundamental concepts, paradigms and tools I could name right off. Many of these pop up again and again in my career, sometimes in surprising places: for instance, the multiple steady states of a chemical-plant reactor can serve as a model for an enhanced-oil-recovery process with complex dynamics.

Coursework-only masters degrees are available at some universities. These degrees allow you to study technology in depth beyond the BS degree but not the experience of open-ended research. In general, they also require you to pay your way, whereas research positions in graduate school often come with free tuition and a (Spartan) living allowance. More on that living allowance below.

A time to immerse yourself in intellectual pursuits - Engineers may roll their eyes at this, but it is of course the motivation for graduate studies in most other departments (in liberal arts and humanities) at major universities. There is a difference between undergraduate and graduate education. Undergraduate education often is satisfied with teaching the students methods; graduate education should teach the fundamental questions and approaches behind the methods. Graduate school is a chance to expand your mind, to ask the questions you didn't have time to ask in college, and to fully

understand the assumptions and limitations of those equations you memorized just before each exam. Graduate school will probably be the most intellectually challenging and rewarding time of your life.

For this reason, it's good to attend graduate school at a different institution from that of your first degree(s). Mixing with a new faculty and student body gives a wider perspective.

An essential credential for a university teaching job - Most large universities require a PhD for a permanent teaching position, in part because these positions also require you to develop a strong research program. Some universities have teaching positions that do not involve research, and some truly great educators I know hold that type of position. The positions are often not permanent or tenured, however; they lack the security and status of the tenured positions that require research.

Press the "reset" button on your career - A graduate degree is a great way to change industries. If for some reason you want to return to a career that was interrupted, a graduate degree can provide an additional credential, source of current recommendations, and (at most universities) a job-placement service to re-enter at a higher level than you left. Many students use graduate school in a foreign country as a way to enter the job market outside their home countries (although immigration laws in the new home country often make that difficult).

In some companies an engineering graduate degree is not the key to rapid advancement up the management ladder. Those who primarily aim for upper management usually do better by getting an MBA. I wouldn't agree with this preference for MBAs, and I am glad that it is not the case in all companies, especially those that excel at technology. If you are already working, you can tell the attitude of your company from the resumes of those at the top; if you are interviewing, you can ask how many of the top company managers hold advanced technical degrees.

If the answer is yes, then when? What is the best time for graduate study: directly after the BS, or after some time in industry? There are advantages to spending a few years in industry first: greater maturity, more background in the practical application of the subjects being covered, greater self-confidence, more focus on the specific goals of your education. Some of my colleagues say their best graduate students have spent some years in industry first. The greater maturity and self-confidence can be a real asset when research or studies are discouraging, as they usually are at some point in graduate school.

There are, however, at least two strong reasons to go directly to your final destination, whether an MS or a PhD: First, and most important, your financial obligations usually increase with age. You may marry, and perhaps start a family, or simply become accustomed to a standard of living above that typical of students. Most graduate schools in the West provide free tuition and some sort of living allowance for qualified students doing research, but the living allowance is nothing like what you would have become accustomed to in industry. When one is young, living on a shoestring budget is acceptable, even romantic. Later in life it can be more of a strain. If you delay graduate school, you risk that it won't be feasible later. Second, usually your math skills decrease with time out of college, and graduate school will force you back to that

calculus textbook you haven't looked at for years. Good students can overcome this, but it is a challenge. A colleague I consulted raises a third issue: Graduate school can be a humbling experience: a thesis or dissertation is an apprenticeship. Greater maturity may help you keep this in perspective, or it may make it harder to accept.

My personal advice is that if you know at the time of completing your first degree that you want a graduate degree, take the opportunity then. But if you decide later on to consider graduate school, look carefully at the economic implications and priorities for your family (if you have one), and take the plunge if you can manage it.

For me, graduate school was the most intellectually stimulating period of my life up to that time; perhaps of my whole life. It was discouraging, struggling with challenging courses and doing research that at times seemed to go nowhere. It was also rewarding as small successes came, and it was great to get to know fellow students, many of whom continue to be good friends. My wife compiled a collage of photos from graduate school that is now on the wall of my office, and at any excuse I pull it down and tell visitors about the people and incidents portrayed there. As Charles Dickens wrote, "It was the best of times, it was the worst of times." Though he did not write this about graduate school, it is an apt description. But know that if you truly love learning, there are far more of the 'best of times.'

