The Dollars and Sense of Continuing Education

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Abstract

Lifetime earnings of a high school graduate of $150 000 can be increased to $725 000 with a doctorate. Continued study is required to "stand still" with an engineering half life of ten years. These points, among others, point to the value of investment in continued education.

Key Words—Education, graduate degree, investment, study, training

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Let us consider education as a form of capital—human capital—and thereby evolve a measure of the value of education to you. Let us evaluate *in dollars* the educational investments which you have made.

TABLE I

School Experience	Value Per Year	Total Value
Public School	$ 5 000	60 000 (12 years)
Undergraduate College	$20 000	80 000 (4 years)
Graduate Study	$50 000	$n \times 50\ 000$ (n years)

These figures are impressive.

Where can a school boy earn $5000 per year in any grade, one through twelve, except in school?

Where can an undergraduate earn $20 000 per year, except in college and studying engineering?

Where can a holder of a fresh, new bachelor's degree earn $50 000 per year, except in graduate school?

These amounts are, in effect, invested to provide improved productivity of the individual. The individual draws these sums over his lifetime with interest on the unspent capital at about four percent.

Here is a look at the overall picture.

TABLE II

Educational Category of Worker	Educational Investment	Average Annual Earnings	Lifetime Earnings
Uneducated (illiterate)	0	$ 1 000	$ 40 000
High School Graduate	$ 60 000	$ 3 750	$150 000
College Graduate	$140 000	$ 8 750	$350 000
Master's Degree	$190 000	$12 000	$475 000
Doctor's Degree	$290 000	$18 000	$725 000

It is crystal clear that if you are capable of successful graduate study, you are wasting your time working! You should be *investing your time* in full-time graduate study right now so as to trade low income years for high income years! *You* could be making $50 000 per year right now. From a purely selfish standpoint, you cannot do otherwise, *even if you have to borrow money to do it.* Scholarships, fellowships, assistantships, and loans are widely available to make your correct decision reasonable.

But one does not want to be *completely selfish.* How about your employer and your country? Dr. Lloyd Berkner, former director of the Brookhaven Laboratories of the AEC and the founder and first president of the Graduate Research Center of the Southwest at Dallas, has developed this point in the February, 1964, issue of SPECTRUM (p. 69). He points out that an engineering Ph.D. generates 100 to 150 new industrial jobs. In short, educationally generated human capital in the form of graduate training is even more beneficial to the nation than it is to the holder thereof!

If *you* have the ability for graduate study, you cannot afford not to start immediately, and our nation cannot afford to "underemploy" you in your present job!

Now for a really crucial question: *Is a graduate degree for you?* The real determinant lies in *you.* How well motivated and how determined are you? This qualification is virtually unmeasureable by graduate school and engineering deans and engineering department heads. So these gentlemen who are held responsible for their decisions by their institutions have found that the most dependable indicator is—guess what?—undergraduate grades and/or rank in class.

It has been estimated that one third of the winners of bachelor's degrees are qualified to seek a master's degree, and that 95 percent of these will come out of the top half of their graduating classes with grade averages of "B" or better. If you have this kind of rank, you have a better than nine out of ten chance of being accepted into a good graduate program. If you do not have the rank or average, the burden is on you to prove that you are in the minority 5 percent that have good mastery of mathematics and an uncanny determination to succeed.

A lucky one third of the winners of master's degrees can be expected to qualify for the doctor's degree. At $50 000 per year investment value, those qualified must realize the fact and make the attempt. For the stakes involved, one can afford to risk flunking the qualifying exams.

Incidentally, if this discussion of investment in graduate education has sparked your interest, there are plenty of universities anxious to give you details on their programs.

I believe enough has been said about the "bookish" boys who enjoy a privileged position for a very sound investment of $50 000 per year. Let us turn our attention to the "salt of the earth"—those engineers who comprise the 67 percent or so who do not pursue a graduate degree. What is for them? What is for most of today's students? Your best gambit is to optimize the yield on the investment you have already made. Experts estimate that the half life of your engineering education is not more than ten years. This is a frightening thought! Your educational investment is like the investment in a farmer's truck or a manufacturing plant. Unless you reinvest by regular maintenance or replacement, your engineering knowledge will be virtually depreciated—have zero value—long before retirement comes for you. In other words, your technical field will run off and leave you. (I believe we all understand this.)

But you need not fear the tragedy of disinvestment if you face, frankly and sincerely, the facts which are brought into focus by the mathematics of the situation.

Here are the facts.

1) You invested 120 weeks as an undergraduate. Let us estimate that you put in a good, solid, 40 hours per week either in class or hard at your studies every one of those weeks.

2) You invested $120 \times 40 = 4800$ hours in your engineering education.

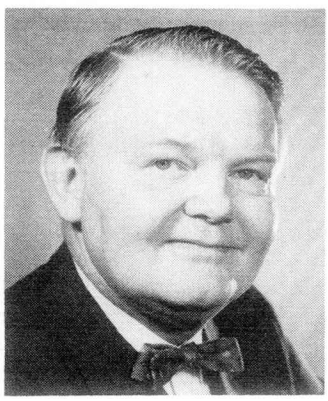
3) $4800 \div 2 = 2400$ hours of your education will go "down the drain" in ten years.

The answer to your disinvestment problem is obvious. You must reinvest, in either formal or informal study, $2400 \div 10 = 240$ *hours every year*. Because I do not believe the financial obligations of most of you will permit you to take off six weeks per year, I suggest to you the steady routine of putting in five hours—one long evening—every week in concentrated study on new technology, mathematics, and science. Of course, you may substitute, hour for hour, the formal opportunities available to you in the form of lecture series, on the job educational programs, and other similar opportunities. (Parenthetically, I ask you to note that you can take off two weeks at Christmas, when nothing very important professionally can be achieved anyway, and two weeks summer vacation; $52 - 4 = 48$ and $48 \times 5 = 240$.)

Take note that you cannot take credit for time spent in applying old techniques to new problems. You can, however, credit time spent in learning new techniques and applying these to any problems, new or old.

I wonder how many engineers invest five hours per week, every week except Christmas and summer vacation, in acquiring new engineering knowledge? Those who do so with reasonable selection of material need have no fear of obsolescence. Those who do not are clearly sliding toward disinvestment. Special courses, lecture series, and such, even if available in a regular sequence, can never substitute for hours of secluded concentration in study and thought. You have heard time and again that you, as an engineer, must commit yourself to a life long learning process. *Life long learning of engineering is possible only by disciplined life long study and thought.*

Let me add that these thoughts on continuing investment and disinvestment are just as applicable, and even more so, to the "fair-haired boys" who have been fortunate enough to qualify for the master's and the doctor's degrees. For all of us there is no short cut to one's continuing education any more than there was a short cut to getting the bachelor's degree in engineering. Just as a lot of hard studying on one's own was required, so is a continuous budget of hours at hard study required to keep abreast. Special programs and aids are needed. They will help. But the basic responsibility is on the individual. The basic thought processes must be carried out by the individual engineer. He must commit his time and disciplined effort.



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For distinguished service as a Physicist for the Navy on highly classified projects during World War II, he was awarded the Meritorious Civilian Service Award. In 1947 he joined the M.I.T. faculty, where his research concerned computers, nuclear instrumentation, and missile systems, and his teaching gave new contributions to standards and practices in electrical engineering curricula throughout the nation. He was Head of the School of Electrical Engineering at Purdue University, Lafayette, Ind., from 1958 to 1962, where he developed a new curriculum, originated a special undergraduate program for honor students interested in research, and greatly expanded graduate studies and research. He became President of the University of South Carolina, Columbia, in 1962, where he has continued his emphasis on curriculum reform, intellectual environment, special opportunities for honor students, service to state, and graduate studies.

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