

1998 CSM Faculty Senate Distinguished Lecture

Ken Lerner

How Good Are We?

How Good Can We Be?

How Good Do We Want to Be?

Introduction: A Large Part of My Life

Thank you, Sam. Thank you, also, members of the Distinguished Lectures selection committee, for extending this honor to me. And, thank you, colleagues and friends for coming to hear this talk.

You know, first came the flush of a sense of honor in being selected to give this lecture. Then, the panic set in --- "What profound words will I have?" Fortunately, Sam assured me that as long as I wear a jacket and comb my hair, and simply *look* profound, I don't really *need* to be profound.

In any case, I will be sharing thoughts and feelings about something that does have very deep meaning for me --- Colorado School of Mines.

My connection with Mines goes way back, more than 43 years. In high school, exploration geophysics got into my head, and it hasn't left. Then, as now, applied geophysics could be found in very few universities. But the *CSM Bulletin* then was impressive. Do any of you recall CSM's motto in those days? "MEN, minerals, and midnight oil." After one look at that motto, I decided that this school was *not* for me.

But geophysics is what I wanted to do, so I had little choice. It turned out that Mines was the only university I applied to, and I've loved it from the first day here. That love affair survived the 28 years that I was away from Mines, first in graduate school and then in industry, and it continues to thrive now, in my 11th year on the faculty.

Forty-three years, of course, is not close to a record for longevity at Mines. But it's had its milestones. For example, many years ago, while in Denver for a business trip, I had the pleasure of giving a one-off lecture to students in geophysics. At least the *first half* of the talk was a pleasure. Then, about midway through, I realized that most of the students hadn't yet been born when I first started at Mines! That ruined the rest of the talk.

But that was long ago. Now, I struggle with the fact that the *parents* of most of my students today hadn't been born when I started at Mines! But, enough of that. Sam said that my talk wasn't supposed to turn bitter.

The Place for Me

The point of all this history is that Mines has been a large part of my life for a large part of my life. I feel as if I was born to be here. I care about CSM, just as I suspect all of you do. And *I like it*. Why not? What's not to like?

- * I'm fortunate enough to be able to work and teach in my chosen profession.
- * I have wonderful students to inspire about the wonders and beauties of geophysics.
- * Sometimes, these students even open their eyes in class!
- * I have wonderful colleagues in the Geophysics Department whom I both admire and have fun working with.
- * All this and much more, and I can do it in God's Country --- beautiful Colorado.
- * I'm where I want to be. What good luck that my *job* is teaching at Mines!

Talk about a bed of roses. It's *perfect*, and couldn't be better!

Or, could it? I signed on to teach, learn, inspire, be inspired, mentor, motivate, and be motivated. I don't recall rushing back to Mines to serve on committees, worry over curriculum across campus, do battle over teaching philosophy, fill out assessment reports, try to ferret out the meaning of ABET criteria, or second-guess ABET visits.

So, it's far from perfect. But, Mines remains absolutely the place for me.

I Want it to be Great

But I have this thing --- a drive for the people with whom I work and the institution in which I work to be *great*. I had this obsession when I worked at Western Geophysical Company, and, for sure, it holds for me here at Mines.

So, how do we measure greatness. I don't know. I don't even know how we measure how *good* we are. Don't worry, this talk isn't going to tackle the philosophical question "what does it mean to be good?"

But, whether or not we can articulate what it means to be good, that shouldn't stop us from asking, "How good are we?" I think we'd be remiss in not doing this. But the task won't be easy. And, I don't think it's done by developing a list of assessment criteria or devising and implementing an elaborate assessment-measurement system.

Years ago, when I was an undergraduate, my classmates and I *knew* exactly how good we were. We clearly knew that Mines was the second best engineering school in the country --- second to MIT. That's not bad! How this ranking was determined, I don't know, but when my classmates and I went to the Corps of Engineers ROTC summer camp at Fort Leonard Wood, we met students from 14 other 2nd best engineering schools in the country --- second always to MIT.

So, perhaps our measurement system then was a bit crude.

The Questions --- Identity Crisis

This question of "how good are we" and the corollary questions that it begs, "how good can we be" and "how good do we want to be," are nontrivial. They were much easier to answer in the old days, the days when we were solely a school of mines, and undergraduate instruction fully dominated our purpose. Not so since the onset of our identity crisis. What *is it* that we're to be good at?

Are we the traditional school of mines or a broad engineering school? Or both? Can we be good at being both? Are we a teaching institution or a research university? Or both? If both, can we hope to be good at being both? Do we wish to be an *elite* engineering school? Perhaps not. These questions are difficult to answer, but I don't think we've made much of a start at even *asking* them.

Historically, by whatever measure, I believe we've been among the best of schools of mines, and, for the most part, our quality has been measured by the quality of our undergraduate program. Our history as a research university is much shorter. Also, our latecomer degree-granting programs did not start with the advantages of position and history enjoyed by our traditional ones. Perhaps, for example, in another State and in another time, in allowing us the degree-granting privilege in engineering, instead of saying "oh, all right, if you must, you can have this program," the CCHE and State Legislature might have said "Great idea! And here's the funding for you to make this program world-class!" But, it didn't happen that way.

In addressing these questions of who we are and who we want to be, we're confronted not only with a question of *intent*, but, unavoidably, the large issue of *budget*.

Some Opinions

It's not for me to answer these questions here --- even if I had answers. But these essential questions at least must be raised and addressed. They're tough, and dealing with them will entail struggle and pain.

Well, I don't have answers, but I do have opinions, and this is my opportunity to share them. These opinions come as much from the heart as from the head. Many of you will agree with much that I have to say since the ideas aren't altogether original. Likewise, plenty of you will have much with which to disagree. That's as it should be. My hope is that the opinions stir thoughts, both today and afterward. First, let me list some, and then elaborate.

1. we must maintain our tradition of excellence in undergraduate education in engineering
2. we cannot afford to compromise on the strength of the traditional, internationally renowned, minerals- and energy-related programs
3. we must bring the newer programs up to comparable national ranking
4. we've shown signs of being a research university, and we must strengthen that direction

Let me elaborate on why I want all of these things.

* Undergraduate education is our strength. How foolish it would be to strike off in

any direction without building on this strength. Leading research universities these days are much under the gun for having ignored undergraduate education. They're struggling to get to the good place where we've always been! So, on undergraduate education --- yes.

- * CSM's reputation is founded on its pre-eminence in the traditional disciplines. The minerals industries continue to be boom-and-bust, up-and-down. Nevertheless, throughout its history, Mines has superbly weathered this volatility, and come out with its international reputation maintained and strengthened. Not until our more recent degree-programs have established a comparable international reputation can we afford to forsake the core tradition of our school. So, tradition --- yes.
- * But, these later-arriving, degree-granting programs aren't only large, they're *sought-after* by students, and offer graduates great promise in breadth of preparation. The traditional minerals-oriented programs may constitute the *heart* of Mines, but engineering, computer science, physics, and the like now form the *center of mass*. The reputation of Mines requires that we invest heavily in the success of these programs. The road will be difficult. Competition across the country is large and, in many place, better established. So, new programs --- yes.
- * But, do we need to be a research university as well? I see no hope of earning top recognition for our undergraduate program without successfully attracting and keeping the best and the brightest, as well as the most caring, of scientists, engineers, and educators. For the core, lower-division and some upper-division courses, we likely need instructors who are educators, first and foremost. But, to provide world-class education in the more field-specific, upper-division and graduate courses largely requires people of a mind and talent that their drive is to do leading, innovative research in an environment that richly fosters the best in research. So, research --- yes.

So, you've figured me out. Simply, *I want it all* --- to be all thing!

That's nice. What I want. The important opinion on this must come from the CSM community. Is *it* ready to articulate what *it* wants?

Let's suppose that the CSM community is as greedy as I am and also wants to have it all. If so, however, we will at least have to recognize how formidable, painful, costly, and long-term will be the task.

Education versus Research

In how many of these areas can we compete with the best of institutions? Is this a realistic goal?

Let's go straight to what I believe is a central question. Can we be world-class both in undergraduate education and as a research university? Are these two goals perhaps antithetical? Not inherently. The bright young faculty we've hired in recent years show great talent for both. The challenge comes from budget limitations --- budget as measured both directly in dollars and in time, productivity, and quality-of-life for faculty.

Is it realistic to expect faculty members to be productive in research when they are

burdened by heavy teaching loads? This is foremost a budget issue. Count up the numbers of undergraduates, of sections of courses, of graduate students, and of faculty. This isn't rocket science (it's not even mining science). In no leading research university does the faculty carry the teaching load that is expected of Mines faculty.

This problem exists no matter in how we carve up a faculty member. That person could be drawn and quartered both to teach extensively and to do quality research. Or, perhaps we could have specialists who do research with a minimum of teaching, and teachers who have large teaching loads while expected to do little research (with comparable credit given for excellence in either area). Neither alternative truly would alleviate the basic budgetary problem. However a faculty member is carved up, we still have the same numbers of undergraduates, course sections, graduate students, and research tasks to service.

Although it doesn't truly alleviate this budgetary problem, I believe that our system is most efficient and cost-effective, and faculty are most productive and efficient, when we don't ask each faculty member to cover the entire territory of university needs. Let's have instructors and academic faculty *who love doing it and are outstanding at it* teach the core undergraduate courses, without the burden of their having to struggle for research funding. And, let's have true world-class stars in research who can concentrate on what they do best. They would also teach, of course, and we would ask excellence of them in their teaching, but their teaching load would be sensible as it relates to expectations for research performance.

Traditional versus the New

When it comes to trying to be all things, the easiest should be to maintain our preeminence in the traditional, mineral- and energy-related fields. So, let's do that. Without undergoing an elaborate assessment process, we can know that we're good, very good, in these fields.

Let's now come to the center of mass, the Engineering Division. Again, unfortunately, the State Legislature didn't endow us with the largess necessary to transform what had been a service department into a world-class engineering program. Moreover, we haven't been able to hold back the tide of student interest in the program. Fortunately, however, CSM's Engineering Department, now a Division, could bring to the task a great experience in and caring for the undergraduate program. I believe that the Engineering Division has done remarkably well in lifting itself by its bootstraps, and employers have voted that its graduates are desired.

How good is it compared with the norm around the country? I don't know; there's lots of competition out there. One thing that Mines has going for it is a tradition of excellence, which imposes a good sense of what is quality in engineering education.

Actions That Will Impede Us

I'd like to give a list of actions that I believe will help us as we strive to spread

excellence on campus. Before doing that, I'll first give a list of actions that I believe are *not* helpful. This is the curmudgeon part of the talk.

1. I believe that it's harmful to depart from emphasis on strong grounding in the fundamentals of science, math, and engineering. I admit to a large distrust of award-winning innovation in education, whether it is in K1-12 or in the university. Innovation does not equate with quality.
Look! I'm a Mines graduate, so expect conservatism.
2. Similarly, I believe it's a mistake to think that the successful engineer or scientist in the coming century and millennium requires an education that differs substantially from what has been time-proven. For example, I would slow down the rush toward integrated systems courses early in the core curriculum, before the fundamentals are in place and assimilated.
3. Another step that I don't favor is pushing enrollment beyond current caps. We're already large! I'll return to this point later.
4. I think we should be wary of listening too much to "what industry wants" and "how industry does things" rather than *informing industry* of what *it* needs. Industry today is suffering under the weight of Wall Street, driving decisions to the short-term. Perhaps the university will be the last bastion of strategic thinking.
5. We should likewise be wary of industry's rush toward fashionable trends such as re-engineering, re-structuring, re-designing, re-inventing, re-defining, re-focusing. Re-everything-ing! If it weren't for re-search, I'd do away with all words that start with 'r-e.' We've seen, for example industry attempt to foist on universities jargon such as *TQM*, whether it has worked there or not. It's what I call the *hell-week syndrome*. "If we had to do it, you're darn well going to have to do it, too." (I guess you all know what TQM stands for --- *This Quarter Mentality*.)

I told you this was the curmudgeon part of the talk.

We help ourselves to the extent that we don't buy into jargon, one of the great impediments to thought. We help ourselves when we replace *Total Quality Management* by mere *quality* --- lower case.

Catchwords simply won't help us along a good path. I recall the catchword of the day in the U.S. military during the 1960s, *ZERO-DEFECTS* --- and that was during the Vietnam War no less!

6. Something else I think is unhelpful as we strive toward greatness is worrying over showing ABET that we're a good enough engineering school to meet its standards. We're much more than good enough, and the measure of this *isn't what we show ABET visitors*. Why is it that we breathe such a sigh of relief when we've successfully passed an ABET review? ABET evaluations are for lesser institutions, schools with standards that may have slipped so that intensive effort is needed to impress the ABET visitors. Do MIT and Caltech agonize over ABET visits? I think not.
7. By the same token, we should be wary of developing and implementing elaborate

assessment-measurement systems. To me, that's time wasted; it's detrimental when we have important things to do and precious little time. We know when we're doing things right.

For that reason, I much favor old-fashioned *soul-searching* --- of the sort that my colleagues and I in geophysics have started doing. We've got good people in our department, as is true in other departments. These good people know how to work individually and together at improving their courses, their program, their mentoring, and their collaborations. Such continual effort at improvement is accomplished by professionals who care. There's the *catchwords* "continuous improvement," and then there's the *promise* in simply continually striving to improve.

As an aside, I believe that the ABET 2000 guidelines are excellent; they're a great aid to program improvement and basis for soul-searching, so long as they are taken seriously as simply *guidelines* for program-improvement. The problem arises when we feel the need to devise scoreboards for outside evaluators.

How *good* is a walk in the woods? How good are the *woods*? I don't think we need a 10-point assessment plan to get the answers.

Elaborate assessment systems are deemed more necessary the further removed the evaluator from the program being evaluated. They haven't worked in either industry or government organizations. They're time- and energy-consuming, and thus counter-productive.

Steps That Can Help

Okay, we've just had five or so minutes of complaining about what I don't care for. I ought to devote at least *a minute* to positive steps that we might take.

1. I've already admitted to a distrust of grand innovative approaches in education. I greatly value, however, the interactions with my colleagues on the geophysics faculty when we soul-search and share ideas on teaching --- on alternative methods for delivery of course material that seem to have worked well in one course or another.

One innovation that I think offers important promise for the future is the fledgling approach of writing across the curriculum. Perhaps this can be the forerunner of something really large and different --- *continuity in education* across the curriculum. For example, how about introducing *computing* across the curriculum, *creativity* across the curriculum, *wonder* across the curriculum, *ethics* across the curriculum, *humility-about-engineering* across the curriculum, and *humanity* across the curriculum. In short perhaps we faculty can strive to be *role models* across the curriculum. We might do this by introducing bits of awareness in these various areas into all of our courses.

Once we pull off something like this --- and this would take some time to do --- wouldn't we have a paramount educational institution? This wouldn't happen soon, and it can't happen by edict. If it were to happen at all, it would be by starts here and there, and only by faculty who buy into its value.

2. Here's another step to consider --- seriously, I hope. Suppose we actually *reduced* the size of the undergraduate enrollment, and did so by *raising* and *refining* our entrance standards? What would be the price? Lost tuition, of course. However, if we let that be the stopping point, then let's face it, we would be acknowledging that the quality of CSM into the future is driven solely by economics --- plain and simple. While there's no avoiding the School's tight budgetary constraints, any considerations of where we would want Mines to head into the future should never *start* with the budget.

Benefits in reducing undergraduate enrollment through a raising of standards. Let's consider some possibilities.

- * This would require the teaching of fewer sections in the freshmen and sophomore years, thus reducing faculty loads.
- * With a stronger student body, courses could be taught more efficiently and more effectively; for example, a higher fraction of courses could be honors ones --- the sort that better motivate both students and faculty.
- * Relatively more highly motivated students will better motivate their classmates.
- * The percentage of students who complete the program at Mines might increase.
- * Students might finish their undergraduate careers in less than the five or so years of today, thus reducing the cost of their education.
- * CSM's reputation would be enhanced, thus attracting students of ever-higher caliber.
- * By thus becoming a more elite school, we could charge higher tuition to out-of-state students (oh yes; there is TABOR).

Which direction do we choose? To take the inter-related steps of gradually reducing enrollment while gradually increasing entrance standards, or simply respond with increased enrollment to the expected increase in State population?

This raises yet another question that ought to be addressed. Would we *want* to be considered an elite school? A Caltech or MIT? (By the way, the undergraduate population of Caltech is about 800 students.) Not necessarily. Perhaps we're satisfied just to know that we have the highest entrance requirements of any university in the state of Colorado (not among the most exemplary of states in its support of education). We might prefer to be just a good engineering institution that educates for society, primarily Colorado society, a goodly number of hit-the-ground-running engineers. Where do we wish to be on the continuum between elite and "good enough to pass the ABET visit?" Have we given sufficient explicit thought to this important question?

My own feeling is that, whether or not we actually achieve elite status as an engineering school, we can't afford not to *aspire* toward the goal. Remember all those other second best engineering schools. They're no more content to remain second best than are we.

The pursuit of such a goal, if we chose to seek it, would entail long-term commitment. Easily, decades --- that is, decades starting from the time when we first identify the goal and seriously go after it. The process would have to be a staged, incremental one, and we would likely pay the penalty in lost tuition before the benefits start to accrue. We should also recognize that the first increment in raising the threshold index for entrance to Mines does little more than overcome the moving targets of high-school grade inflation and SAT-performance inflation.

I think that no step is more important to reaching toward such a goal than the next one on my list.

3. We must be uncompromising in seeking to improve the quality of the faculty through intensive international searches. Perhaps the greatest legacy of George Ansell's leadership, in addition to what he accomplished for CSM's endowment, is the change of culture toward hiring only faculty of the highest quality. The difference is all around us today, and the benefits will be with us into the far future. Outstanding people will attract more outstanding people (both faculty and students); they'll make quality decisions; they'll spark students; and they'll drive themselves, their programs, and the School to continual improvement.

The rule is a simple one. Forget how we *define* quality. We know it when we see it, and when you have good people, you have a successful institution.

4. We're a great institution when we're an institution of heroes. A few years ago, we heard a CSM Distinguished Lecture that was memorable for me --- Joanne Greenberg telling us of heroes in her life. Within the Geophysics Department, elsewhere on campus, and among colleagues in industry, my life has been blessed with a wealth of heroes --- faculty who teach superbly, or are so prolific in seminal research contributions, or who offer help and time in improving the character and quality of the program, and students who energize me with their spark of joy in learning, or run circles around me in their attack on research.

It's plain fun to be surrounded by great colleagues. *People* are the key --- people who may be *better than us* at one or many things that they do. We have that in geophysics, and it's fun. Each of us is a stronger scientist or engineer or educator than the other in one way or another, and we respect that. When we're all heroes in one modest way or another, we have all the makings of a great institution.

Likewise, when we care about the *success of our colleagues*, we have then given meaning to another one of those jargon catchwords --- *collegiality*.

5. This is great. I've got you here, and can go on and on with all my great ideas for what makes a good school. Here's another one. We're all professionals; we're thoughtful, and we've all got good ideas. We've got much to offer the Administration and the School. So, we should bombard Ted Bickart and John Trefny with email conveying all these good ideas. Don't worry about troubling them. That's what they're paid for. Ted needs to go out and sell the School, and we can load him up with great information in this way.

It's not *us* (the faculty and staff) versus *them* (the Administration). I like to quote a great geophysicist and mentor of mine, Carl Savit, on this *we-they* issue. In

speaking of offshore seismic exploration surveys, Carl said "In any two boat operation, the guys on the other boat are always stupid."

Well, that's not true here. Our leaders value and need our thoughtful input. It's all *us*, and we all want to build and maintain greatness at Mines.

Conclusion

It certainly can be argued that, with budgetary and legislative constraints, we do not fully control our fate. Perhaps so, but it behooves us, nevertheless, to push the bounds of the extent to which we can. But we can't do that unless and until we start by searching out who we are and who we want to be. Then, we can fix on our target and a plan, no matter how long-term, for getting there from here. At the same time, we can ask our Administration to push those bounds at the State House.

To help focus on some of these issues, we need to get specific. Samples are

- * what should be the total enrollment? total faculty numbers?
- * what should be the faculty make-up? (should each faculty member be all things, or can some be valued for their particular strengths?)
- * what should be the ratio of numbers of undergraduate to graduate students?
- * what should be the ratio of numbers of masters to PhD degrees?
- * are we willing to set new goals for entrance requirements?
- * what is the relative important of distance learning? (let's not be driven primarily by its novelty)
- * can we rationalize the relationship between policies and goals (e.g., overhead and non-resident tuition charged to support of international graduate students as opposed to the goal of increasing research support; graduate versus undergraduate scholarship support in light of the goal of increasing graduate enrollment)
- * finally, we need to set a long-term plan for getting there from here, with minimum upset to budget and culture

Subsets of these questions certainly have been addressed at CSM, usually by select committees, but often, I think, in the absence of a serious inquiry into who we are and what we want to be. Rather than starting in select committees, I encourage discussion among groups of faculty and in departments across campus --- not because someone in the Administration or Board of Trustees or the Senate asks us to do it. But, because it's our target future.

At last summer's Geophysics Department retreat, we found that we accomplished more in three days than in years of school-year faculty meetings. When you're off in a retreat such as that, you *want* to tackle big questions.

Such discussions may have great importance for our future. Quite apart from that, however, when each of us is first-rate individually at what we do, when we're working energetically and creatively at what we do best, when we're out there helping our colleagues succeed, the net result is an institution of the highest quality. And *that*

doesn't rest on budgetary questions.

Thank you very much for your kind attention.