

COMMENCEMENT ADDRESS

Carlo J. De Luca  
Dean, ad interim



BOSTON UNIVERSITY  
COLLEGE OF ENGINEERING  
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# Technology, Society, and Changing Attitudes

Dean *ad interim* Carlo J. DeLuca

Boston University College of Engineering

Thirty-Fifth Annual Commencement Convocation

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Congratulations. This weekend of festivities is all for you. The parties and the ceremonies, the music and the processions, the celebrities on the platform and the proud parents in the audience mark the culmination of a long series of your achievements.

Your admission to Boston University was testimony to the success of the education that preceded it: the College of Engineering selects its entering classes from among the finest students in the country and around the world. Four years of undergraduate engineering education or one or more years of graduate education is a strenuous experience. Your success in reaching this graduation attests to your intelligence and strength of purpose.

And I'm not talking to you graduates alone. The achievement we celebrate is shared by the parents who were the first to teach today's graduates how to work, how to set high goals and reach them. It's shared by the grandparents, brothers and sisters, and friends who have helped these promising young men and women recognize their own abilities and stretch them. It is certainly shared by all those who have assumed the financial obligations attached to an education at a first-rate independent university. That considerable investment in the future is in itself an achievement.

Those efforts will be rewarded. You young engineers are stepping into a world bright with promise. Engineering offers the joys of continued intellectual challenge and continued achievement. You are part of the team that is changing not simply daily life, but the way we view our society, our lives, ourselves.

Perhaps you have paused to wonder, what constitutes this discipline that you have chosen for your life's work? What is engineering? To find the answer, look around you: all that is constructed by the hand of man was conceived in the mind of an engineer. The contributions of engineers are woven into the very fiber of our society. Technology touches every aspect of our lives and every facet of how we view ourselves and one another.

Let us look at some examples.

This presidential campaign year provides eloquent proof of how the art and science of engineering alter the way we make decisions and act on them. Consider, for example, how over the last century the telephone and telegraph, radio and television have transformed not only political reporting, but campaigning itself. Now in this decade, portable cameras and satellites have made a candidate's every small-town appearance a national event. In order to compete with our busy lives, televised newscasts are ever faster, flashier, more sensational — and more shallow.

Newspapers and news magazines, following suit, have more color — literal and figurative — and less news. The appetite of modern reporting for the sensational and startling can make the tabloids of the twenties look like the *Christian Science Monitor*. And much of what we now accept as political reporting and analysis concerns neither political experience nor political platforms. The press, self-fascinated, reports in much more detail on how the candidates appear in the media: in televised interviews and discussions, and in campaign ads.

The average voter is left to make his decision based on articles and newscasts that, like *Sesame Street*, take the thirty-second spot as their model.

That's the bad news. The good news is that while reporting may not be living up to its potential for depth, the constant bombardment of flashy, oft-repeated information is making every voter at least a moderately informed voter. And candidates are on constant view: they now reap the consequences if they say one thing in the south and another in the north, one thing to farm groups and another to bankers.

Technology has thus changed how we choose public officials. What happens next? Well, for one thing, we may soon be voting from our own living rooms. That technology already exists. Imagine this: a ballot appears on your television screen; you press a button and a written statement of each candidate's platform appears. You press another button and your vote is cast. In a few seconds, the votes are tabulated across the nation and the results are published, again on your television set.

We will then be able to vote not only for candidates but also on national policy issues. When that happens, how may it change the nature of representative government and, particularly, the role of Congress? Will we be making decisions for ourselves, without political influence — but also without political expertise?

The engineers who came before you supplied the advanced telecommunications that changed the way in which we become acquainted with candidates and choose among them. You, engineering's next generation, will make possible the transformation of tomorrow's political processes. Whether or not you take a hand in using the technology, it will be your creation, your child, your responsibility.

Now consider how technology has altered the delivery of health care. Walk into any hospital and you will see the glory of engineering. The hospital has become the

temple of our most honorable technology. And as technology assumes an increasingly major medical role, the center of health care delivery is shifting from the doctor's office to the hospital.

Technology intersects our lives even before we are born. Sound vibrations passed into the womb of an expecting mother can record the anatomical features of a three-month fetus. Electrodes on the mother's abdomen can indicate the health of the fetal heart. A baby born with life-threatening deficiencies can be placed in an incubator — a surrogate womb created by engineers to protect babies until their own physiological systems are sufficiently mature.

Throughout life, technology monitors and improves health. When our heart beats irregularly, an electronic pacemaker can be implanted to regulate the beat. When our heart stops beating, it can be reactivated with an electrical shock from a stimulator. When our kidneys fail, our blood can be purified by dialysis. When our neuromuscular system malfunctions, its electrical signals can be detected and analyzed to determine the location and the cause of the problem. And finally, when the body becomes weak and prepares to die, technology can prolong its life.

Even more dramatic medical technology lies in store. Limb prostheses and orthoses, now in a primitive state, will rival their natural counterparts. Artificial internal organs — hearts, lungs, bowel segments — will be standard, off-the-shelf items. The blind will see, the deaf will hear, and the lame will walk. The dying will live longer, nature's course having been confounded by our enhanced abilities to maintain some organ functioning under extreme physiological stress. We wrestle with God for sovereignty over the moment of death.

Computers are gaining a place in our daily lives, often without our awareness. We have already seen what happens when computers buy from and sell stocks to one another. People need take no action — but it is people who can lose their savings and their security.

Sophisticated artificial-intelligence programs soon will be called upon to make other instant decisions, ranging from medical treatment of an individual to treatment of water for a city to deployment of weapons capable of destroying a nation. Who will be responsible when the machine miscalculates? No present law governs such circumstances. Will future laws hold machines responsible for their actions?

Armaments have become so technologically sophisticated that we can now kill en masse without offending any of our physical senses. We needn't see or hear our victims. We needn't even know where they are — our machines will find them. We have developed this terrible power to protect ourselves. And now some perverse logic compels us to sell these weapons to our enemies, so that to feel safe we must create even more powerful weapons — which will also be for sale.

You will develop this future technology. Your instruments will provide undreamed-of options — and they will potentiate moral quandaries. Your work will create ethical questions that will touch every government; your discoveries will fashion legal dilemmas that will dominate courts and legislatures.

Generations of philosophical and religious teaching leave us ill prepared for the complexities that await us. Aristotle could say with confidence that every human action is directed at some good, so that, for instance, the goal of the healing art is health. How would he have dealt with our obligation toward the infant born without a brain: is it *good* that such a child be kept alive, through our technology, to become a source of transplantable organs to improve the health of other infants? The advancing dilemmas of today's technologically based society requires realistic and pragmatic solutions and compromises. We must come to grips with "the relative good" and "the relative bad" as options presented to us by our technology.

I do not mean to suggest that technological progress is in itself pernicious. Few can doubt that our lives have become safer and more comfortable; freed from long hours of manual labor, we have time, energy, and means to express ourselves and to help those who need our help. Without doubt life will become even better, and more rapidly, as the pace of technological evolution quickens.

From that evolution grows the central dilemma of the engineer. Technology will continue to enter our lives in ways we cannot now even ponder. Harnessed, it can be a force for unimagined improvement and for extending the good life to those imprisoned by poverty, sickness, and disability. Allowed to grow unchecked, it can destroy all that is good in society; it can destroy society itself. To do nothing is to be implicit in that destruction.

As you take your places in the community of engineers, you assume a fearsome obligation. Engineers have created powerful tools; we must take responsibility for controlling them. The education that equips you to understand technology's force equips you as well with the analytical powers and the intellectual discipline to guide that force. As intelligent voters and community activists, as members of school boards and political committees, you must make your voices heard.

And more. Policy-making in this country is largely in the hands of those trained in the law. To keep society in charge of technology rather than to allow the reverse, you who best understand technology must assume an active role in government, in the law, in the press. You must find the solutions to the problems that you create, and you must see that those solutions are enacted.

We who are your teachers have watched your growth with pride and with confidence in your intelligence, your knowledge and skills, and your goodwill. Today we watch with pride as you go forth to use what you have learned. We know you

will use it well in the laboratory and classroom. We pray that many of you will also choose to become leaders in government and in the influencing of public opinion. The men and women who make public policy will determine outcomes once in the hands of God.

The diploma that you are about to receive symbolizes your ability and your obligation. You, the class of '88, graduating from this college and from colleges of engineering around the world, hold the future in your hands.