Innovation and Technology Transfer in Universities

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I AM DELIGHTED to be here today as we focus on technology transfer, an endeavor which could have an enormous impact on our lives in the 21st century. Because we in California are leading this effort, we have a unique opportunity to help set the agenda for technology transfer nationally.

Since the passage of the Bayh-Dole Act some 20 years ago, universities have certainly made progress in streamlining the tech-transfer process. But we still have a very long way to go. I don't believe most universities are making the commitment necessary to succeed in technology transfer. That is the subject of my remarks today – what precisely does such a commitment entail, and why do universities need to make it?

As all of you here well know, technology transfer is a sophisticated and often complex process. It needs significant resources and infrastructure to make it work well.

We in the academy need to refine and enhance the entire process whereby technology is transferred from universities to the commercial sector. We need to set up a technology-transfer infrastructure in our universities that recognizes the realities of the business world. We need an infrastructure that will do more than simply procure a patent and look for someone to license it to.

A tech-transfer center at a university must review and evaluate the basic research being done by faculty, develop innovative applications for new technologies, explore the viability of markets, evaluate the com-

petition, oversee intellectual property concerns, procure investment capital if needed, develop corporate relationships, and utilize the entire process as a learning experience for students.

The tech-transfer apparatus at a university must be flexible – able to adapt to different businesses and business conditions. It must develop ties to business that go beyond a one-patent-at-a-time relationship. Universities especially need to develop long-term relationships with businesses – relationships that foster a continuous stream of technology transfer. This approach will also allow faculty to remain focused on research, freeing them from direct involvement in the tech-transfer process for which most of them have little time, skill, or interest.

Technology transfer centers on our campuses must be able to keep pace with the high rate of change in the profit-seeking sector. That rate of change was illustrated by a recent survey of Silicon Valley CEOs that revealed that 60 percent of the high-tech items they manufacture today did not exist 10 months ago.

To be effective, a campus-based tech-transfer center cannot simply broker a connection between university researchers and business; rather, it must add value to the technology developed by the researchers. It must make the technology *more attractive* to business.

We cannot lose sight of the fact that the value of a particular technology is affected by the perceived uses that can be made of it, the perceived need for it, and the social constraints with which it must contend. In other words, the value of a particular technology depends on the *context* in which it exists.

I believe universities too often assume that a new technology in and of itself will provide the necessary push to market. Nothing could be further from the truth. As a practicing inventor myself, I agree with Thomas Edison that successful inventions are 1 percent inspiration and 99 percent perspiration.

Some studies have shown that 60 percent of a product's value is added during the application stage, and only 12 percent at the basic research stage. Much of technology transfer involves working at this application stage – finding applications unforeseen by the researchers who originally developed the technology.

For example, researchers at NASA's Jet Propulsion Laboratory invented a circuit board for space applications with unique properties – it could be subjected to high temperatures on one side, freezing temperatures on the other, and still function electrically. The researchers tried to market this circuit board on the basis of its thermal properties, but could find no takers. But the Technology Transfer Center at USC's School of Engineering, which is also a regional commercialization center for NASA, discovered that something else about this circuit board was capable of creating commercial interest – it was the lightest circuit board ever made. The researchers initially didn't care about weight, but the marketplace did.

We need to incorporate technology transfer as part of the basic mission of the university. We need to integrate it with the rest of what we do.

Unfortunately, at most universities technology transfer has been relegated to the periphery of the academic enterprise. Universities see it as a derivative process – they assume all the real work takes place at the level of the academic researcher. Tech transfer is now an ancillary activity, often located in offices of technology licensing that are usually understaffed and underfunded, and that act more as gatekeepers than facilitators.

We can't ignore the fundamental importance of technology transfer. The prominence of technology in modern life is a new element in the history of civilization. It is one of the primary forces shaping the evolution of our society.

Moreover, science and technology over the past 60 years have become, and continue to become, more and more tightly fused. Their relationship has become more dynamic, their boundaries more fluid. Science often gives rise to new technology, and technology is often used to advance science. The nature of technology itself has changed also; its reach, if anything is more widespread than in the past. It is more adaptable and has many more applications.

I've sketched a general outline of effective technology transfer at universities. But what form might that outline take in real life? One such incarnation has been created at USC – the Alfred Mann Institute for Biomedical Engineering. The institute was established three years ago through a $113-million gift to USC from biomedical entrepreneur Alfred Mann. We believe the Alfred Mann Institute (or AMI, as it is known) is unique, a model for the way tech transfer should be done. It provides a real bridge between university research and industry. It truly recognizes and understands the needs of business, and it works to add value to the technology produced by faculty at USC.

AMI resulted from Al Mann's vision that much of the technology developed at universities is sitting on the shelf because of a lack of resources in the tech-transfer process. Mr. Mann wanted to create an organization that would move biomedical technology more quickly from the research laboratory to patients.

AMI focuses not only on research, but on product development as well. The institute assembles a whole product development package. AMI enables a commercial partner to obtain a license not just for a technology, but for a manufacturable product, with AMI retaining ownership of the intellectual property.

The staff at AMI can do everything from specific research to product testing. They can build a high-quality prototype, do the initial clinical trials, and find a commercial partner – either with an existing business or through the creation of a startup. They can make whatever arrangement with business they choose in order to more quickly get a product to market. AMI can tap resources throughout USC, as well as outside the uni-

versity when that will help it achieve its basic mission of technology transfer.

AMI seeks out promising biomedical technology within USC and studies it for commercial viability. What's the demand for this technology? Can it hope to receive FDA approval? Will health insurance companies be willing to pay for the use of the technology in treating patients? How does it stack up against competitors? How strong will the patent position be for this technology?

An example of the technology that AMI is developing is three-dimensional, high-resolution ultrasound tomography for breast cancer screening. AMI is also developing implantable neural stimulators – both for therapeutic purposes and for functional restoration. In addition, the institute is working on a noninvasive cardiac output monitor, along with five other projects.

AMI employs product development engineers who know what it takes to develop a product in a regulated industry. They help the researcher move the technology to a successful product in the shortest time possible. AMI manages all of the practical details never addressed in the research project itself – all of the details that universities have traditionally never dealt with in the tech transfer process.

And here's another thing that AMI does which is particularly important – the institute can give funding to science and engineering faculty to help them complete their research, without all of the red tape associated with government or foundation funding. The institute can approve such funding in less than a day. AMI also recognizes the academic mission of the university and does not impose burdensome restrictions on publication of research findings.

Consider the case of research conducted at USC which has been funded by the National Institutes of Health. NIH stipulates as part of the funding agreement that the researcher must give preference to small businesses during the tech transfer process. But small businesses generally lack the human and financial resources to carry out the procedures which are necessary to get FDA approval, which in turn is necessary in order to get the product to market.

For a given medical device, the FDA wants full specifications for the device, full test results, a hazard analysis, a failure analysis, and great amounts of other information. The researcher has produced none of this, because it is unrelated to his basic research project. In fact, he is probably unaware of the FDA requirements.

As a result, a small business must in effect re-create the entire research project in order to meet FDA requirements. That's a process that can take years. This puts a tremendous strain on the company, sometimes forcing it out of business altogether or forcing it to give up the project. But AMI will do all of the work necessary to turn a new technology into a commercially viable product and to get FDA approval for it.

The royalties from licenses or equity income which AMI receives are split four ways: to the inventor, to AMI to reinvest, to USC, and to Al Mann's foundation.

In its brief existence, AMI has not yet taken any of its projects to market. It has about eight projects underway at the moment. AMI has set a goal of developing 20 projects simultaneously and bringing 65 to 75 percent of its projects to market.

The institute also offers a valuable real-world educational experience for USC graduate students and postdocs. Some are actually supported directly by AMI and do their theses on AMI projects. Faculty members from many departments and schools at USC are already working at and with AMI.

To enhance its effectiveness, AMI has a unique status within the university. It is a separate, nonprofit corporation affiliated with USC and operating on our campus. USC faculty and administrators form half of AMI's board of directors, while Mr. Mann's foundation names the other half. AMI's $100-million endowment gives it a significant measure of independence. This allows the institute the flexibility of looking across the entire university – from the medical school to the engineering school – in search of promising new technologies.

As we all recognize, technology transfer at a university cannot be successful without strong support from the top. It must be a university-wide mandate. Universities can and should do more to instill a climate on campus which will enhance their ability to do tech transfer. That approach begins with the university's top leadership. If the president and the provost aren't enthusiastically supportive, tech transfer will never take hold.

Moreover, each university must look carefully at its surrounding community to determine how well the economy of the region matches up with the strengths of the university. Stanford University, for example, has had an outstanding symbiotic relationship with its surrounding community for decades.

At USC we have made it a priority to build on the strengths of the region in which we are located. Los Angeles and Southern California enjoy a very diverse economy. But there are two areas in which the technological strength of Southern California matches up especially well with the strengths of USC and other research universities in Southern California. That is in the areas of biomedical technology and communications.

Almost everyone would agree that California in its entirety is the world center of the biomedical technology industry. But most people would say intuitively that Northern California dominates over Southern California in this field. However, as counterintuitive as it may be, exactly the opposite is true.

When I say Southern California, I do not mean simply Los Angeles, or even the combination of Orange County and Los Angeles County. Rather, I mean *all* of Southern California, from San Diego to Santa Barbara. When this region is considered as a whole, it turns out that there are more biomedical companies, more employees in those biomedical companies, and more academic biomedical researchers in Southern California than there are in Northern California. In

addition, more biomedical research grants are awarded to universities in the southern part of the state than in the northern. Southern California may well be the dominant area in the world for biomedical technology today, and it will probably remain so during the years ahead.

It also is easy to see why Southern California is so dominant in the area of biomedical technology when one considers the extraordinary array of top-flight research institutions in the area. These institutions include USC, UCLA, Caltech, UC Irvine, UC San Diego, UC Santa Barbara, the Salk Institute, and the Scripps Research Institute. That is quite a formidable lineup, with a strong overall record of effective technology transfer.

One of the most exciting plans currently underway in Southern California relating to biomedical technology calls for the development of a biomedical research park adjacent to USC's Health Sciences campus. If these plans are successful, we will have a 110-acre research park occupied by companies which are exploiting technologies developed at USC, UCLA, Caltech, and other research universities.

Southern California is also the world leader in the field of communications, which includes not only conventional forms of communication, but motion pictures and television as well. The communications industry in Southern California surpasses that of any other region in the world, primarily because of its ability to combine advanced technology with creative content.

USC is a leading player, and perhaps *the* leading player, in communications-related research. Included within its portfolio in this field are:

- The Annenberg School for Communication, which offers a full array of under graduate and graduate degrees in the communications professions.
- The Annenberg Center for Communication, which supports advanced research into the convergence of content and technology. It was created through a $120-million gift from Ambassador and Mrs. Walter Annenberg in 1993.
- The Information Sciences Institute, which has been developing advanced computer and communication technologies for over a quarter century.
- The Integrated Media Systems Center, which is the National Science Foundation's engineering research center for multimedia research.
- The Institute for Creative Technologies, a national center of excellence for research in virtual reality and computer simulation. Created through a $50-mil lion grant from the Department of the Army, it brings together the entertainment industry, the computer game community, the military, and academia to advance the use of virtual-reality technology for instruction and training.
- The Center for Entertainment Technology in our highly regarded School of Cinema-Television.

Most of these centers have active tech-transfer programs because of the good match in technological strengths between the region and the university.

As you can see, I am a strong believer in the value of technology transfer. But I also believe we must keep tech transfer in perspective. We must see it in the context of the ultimate mission of the university.

As a university president, my primary responsibility is to articulate and advance the mission of the university. The principal social value of a university lies in the relationship between individual faculty members and individual students.

We all know that the values and goals of a university are fundamentally different from those of a profit-seeking business, as well they should be. That is, of course, why there is such concern about universities abandoning their academic integrity in an effort to court businesses and capitalize on university research. The more a university begins to act like a profit-seeking business, the bigger the risk that the relationship between the student and the professor becomes compromised. Chasing profits from tech transfer is potentially very corrosive ethically. That is why we need to have strong conflict-of-interest safeguards in place, and why we must constantly guard against undermining the basic purpose of the academy.

But at the same time we have to get beyond the idea that commercialization of university research is inherently inimical to the role of the university. The role and function of universities is evolving within an overall tradition. Innovation does not necessarily mean a break with tradition. Rather, it should mean incorporating new approaches *within* the academic tradition.

There is simply too much at stake not to pursue tech transfer more vigorously, not only for what it can do for universities, but even more important for what it can do for society as a whole. It can add new dimensions to university research, while at the same time providing new educational opportunities for faculty and students.

All of us here have accepted the responsibility of pursuing this new and important agenda. I want to commend all of you for taking on this task, for providing the leadership we need. It's not easy. It's complicated. It involves bringing together two disparate cultures. But I am confident that, given California's resources and leadership potential, technology transfer can and will become a vital source of renewal for our society.