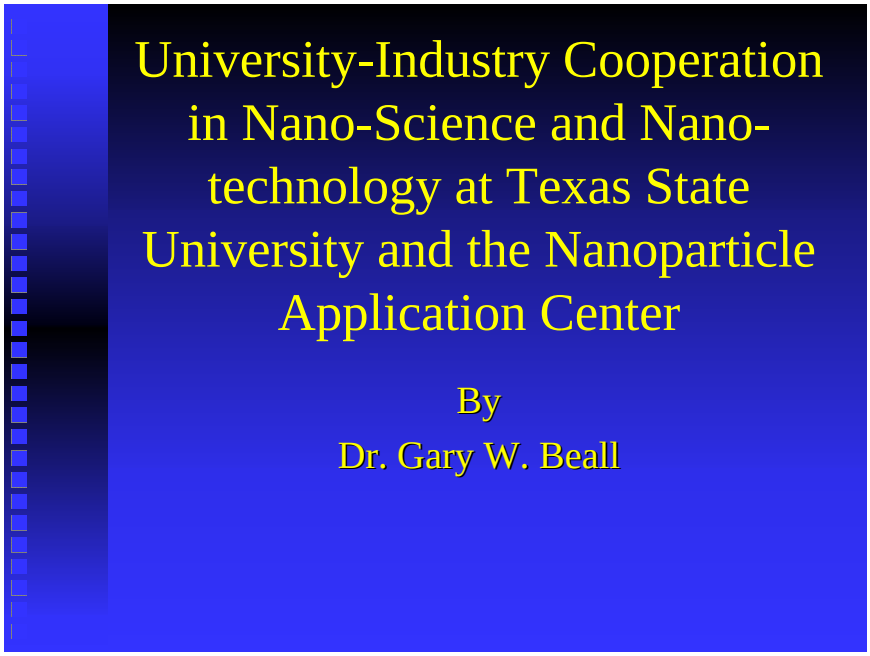
Session 1 Education and R&D in University

University-Industry Cooperation in Nano-Sciences and Nano-Technologies at Texas State University and at the Nanoparticles Applications Center.

Gary W. Beall
Texas State University at San Marcos
2003.7.23.

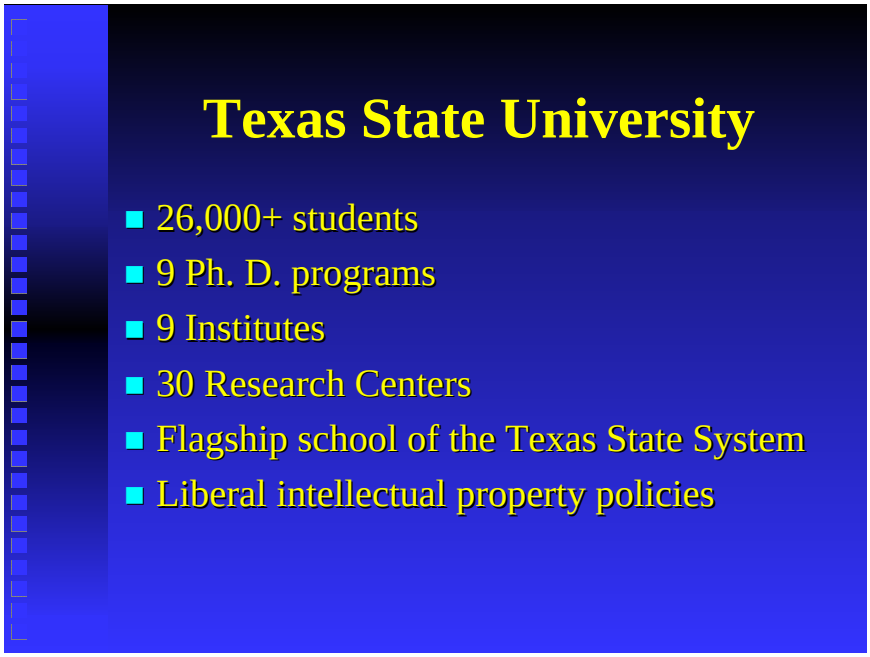
Dr. Yaniv: Prof. Gary Beall from Texas State University will now tell us about the efforts in nano science and nanotechnology at Texas State, including information about the Nanoparticles Application Center just formed there for commercializing nanotechnology.

I would like to mention that Prof. Beall is coming from industry. After 25 or so years in industry, he became a professor, so he will talk more from the aspect of industry than academia.



Prof. Beall: Thank you, Zvi. As Zvi said, I am actually coming from a different background than most professors. I spent 23 years in industry, prior to coming to academe. I have only been at Texas State University for the last two years, so my research is heavily oriented toward an industrial bent. I also, during those 23 years, started my own company and operated it for about five years, so I am also an entrepreneur inside, so that flavors a lot of what I do.

Now my talk is going to be at a different level than the previous talks. I am going to try to talk about actually how we interact directly with industry, to really commercialize material as fast as possible with our research.



Now Texas State University is a very new name. The University was actually established by the Texas State Legislature in 1899 and actually started operating in 1903, so this year is actually our 100th year of operation. We were started as a teacher's college, so we are very different from Boston University in the respect that we are a university that is in transition from going to a teaching university to a research-oriented university. We actually are the largest undergraduate school in Texas. Now, the University of Texas is much larger in terms of total enrollment, but their actual undergraduate student population is about 23,000. This fall, we will hit 27,000 students, and the vast majority of those, probably about 25,000, are undergraduates.

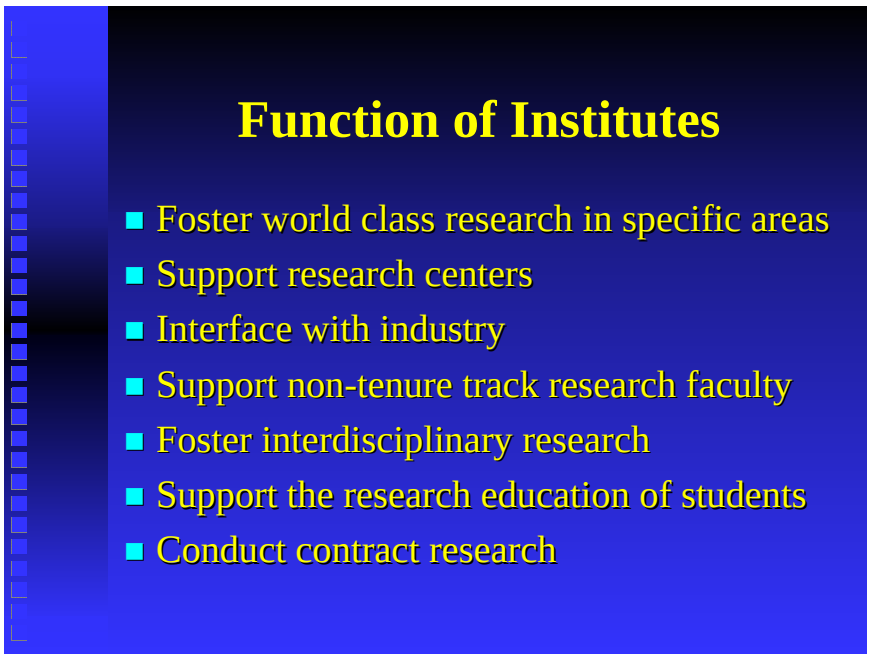
We currently have nine Ph.D. programs. We do not have a Ph.D. program yet in my area, the nanotechnology area. We have plans to institute in the next five years a material science degree that will be jointly operated between chemistry, physics and technology. So we will have three different departments cooperating in that degree. One of the things that the University has done, and I found it interesting that Bob mentioned that Boston University had all of these different entities and now they are trying to get them under one roof. Well, we are still at the stage where we have nine different institutes, and so maybe we will organize all of those at some time in the future. But these institutes are organized around specific areas of research. Within those institutes, you generally have research centers that are focused even more closely on a particular topic.

Now, Texas State University – the name will actually only come into effect September 1 of this year. We currently are Southwest Texas State University. Well, Southwest Texas State University really does not describe the kind of university we are, nor where we are located. We are in central Texas, rather than southwest Texas, and I am not sure where that name originally came from. I have not found anybody to give me a good explanation of where that name came from. We are only about 35 miles south of Austin, Texas, where UT is located, and we are the flagship of the Texas State system.

Now in Texas, we have basically three university systems: the University of Texas system, the Texas A&M system and the Texas State University system. Of this Texas State system, we are really the only school that is making the transition to a research-type university. Most of the others are keeping the education flavor of their original charter. One of ways that I guess that gives us an advantage is we have kind of a blank sheet of paper, since we are creating this new research university. We can do things that other universities might be hindered in doing because there is already a bias of how things should be done. We look at that as a distinct advantage and one of the areas that our university is very liberal about is our intellectual property policies. For instance, at the University, whenever we license technology, the professor actually gets 50% of the royalties and the school retains the other 50%, and some of that is distributed to the departments and the deans. That policy really provides an incentive to professors to be innovative because they, at the end of the day, will benefit directly by that licensing of intellectual property.

This is a picture of about a third of our campus. The building there is the oldest building on campus and I think it was open in 1903, so it is about 100 years old.

Now, what I would like to focus on is some of the structural things that we have in place that, hopefully, are going to make us successful at being cooperative with industry and getting technology out there and creating jobs because, ultimately, that is our goal – to create technology that will create jobs for people. The functions of the institutes are first to foster world-class research in specific areas, and they do that by creating an environment where the various centers can operate under that umbrella to support the research centers that are focused more narrowly on particular subjects to interface with industry. This interface takes on many, many different faces.

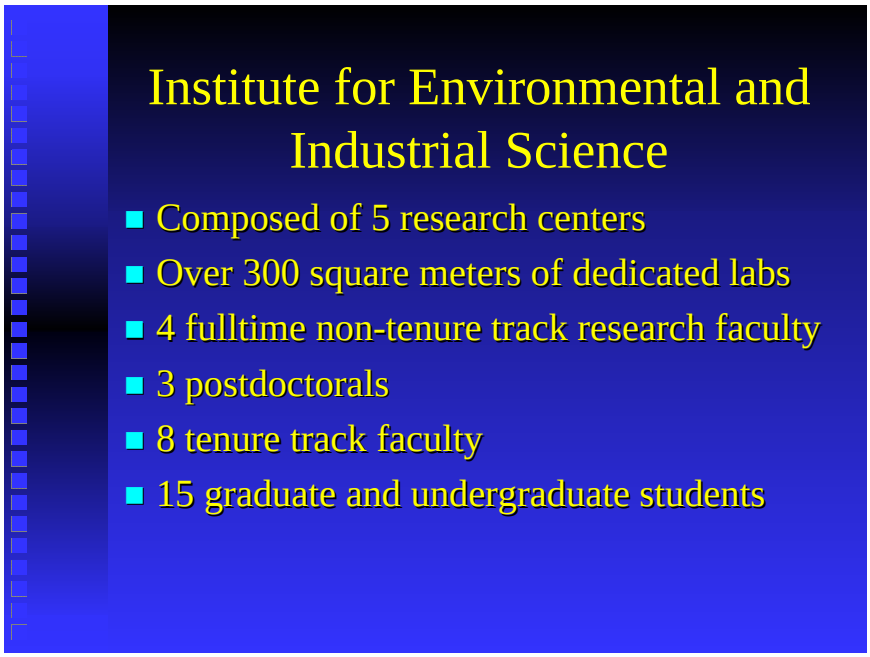


One of the things that the Institute allows us to do is to work with industry and not be encumbered by very large overheads. A lot of industries object to universities tacking on a very large percentage on top of the grant to do research with industry. Our overhead at the university is not terrible – it is about 46%, which compared to a lot of schools is quite low. But within the Institute, we can interface with industry and only add about 15% overhead charges to the research.

So industry loves not having to pay those extra dollars on overhead. The Institute also helps us to support non tenure track research faculty. At a lot of the institutes we have permanent staff that are Ph.D. researchers and they are adjunct professors so they may occasionally teach a course, but their principal focus is doing research. It allows us to have that faculty around and to focus strictly on research. It also allows us to foster interdisciplinary research; a lot of the problems we face today are not going to be solved simply by the chemists or the physicists or the technologists alone. We need to have cooperation amongst those groups. The institutes allow us to do that, so that we get out of the politics of the individual departments and can work under an umbrella organization where you are not concerned about those politics.

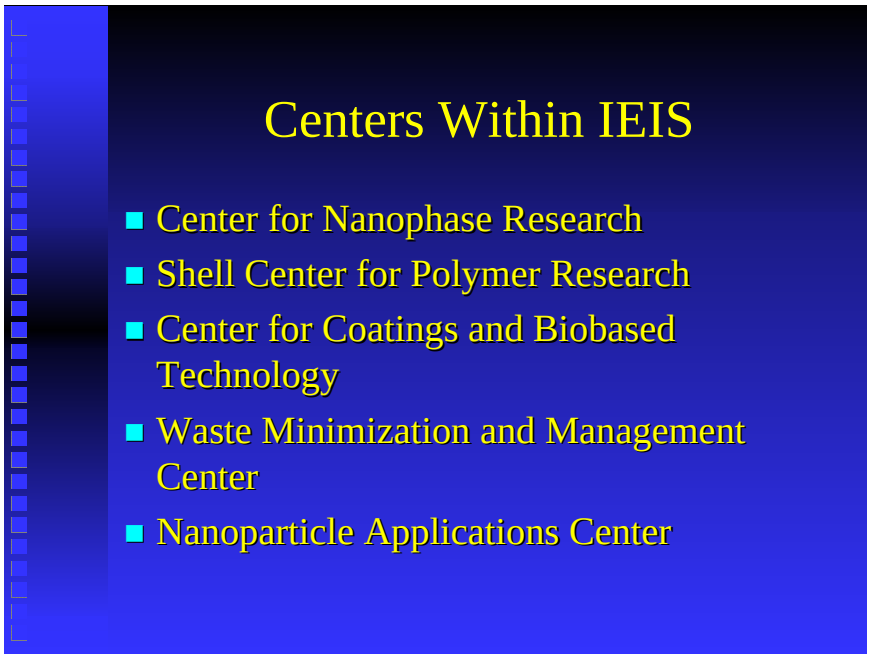
Also, to support the research education of students. To give the students an opportunity to do research in many, many different ways that is quite different from the traditional research that they would do in the department and that generally is very narrow in focus.

Then, also, to conduct contract research. What I mean by contract research is research that a company may want done that is not terribly fundamental in nature. But they can get research done at a very low cost that is spelled out as a set of tasks that we can do, and this kind of research we have mainly done with undergraduates because it does not involve any kind of thesis work, yet we can get a lot of cooperative work done with industry by doing that.



What I would like to do is to focus one particular institute – that is the Institute of Environmental and Industrial Science – and describe the structure of that institute. It is composed of five research centers, and I will talk about three of those later in more detail. We have 300 square meters of dedicated labs, and this is important. It is not very large, but it is important because those facilities are independent of the individual departments. Cooperative research can be fostered better by having facilities that are not under control of the physics department or the chemistry department or technology department.

We have four full-time, non tenure track research faculty that work within this institute and, generally, three post-doctorals pretty much full-time; we have eight tenure track faculty that work from different departments within this institute; and we generally run fifteen to twenty graduate and undergraduate students within the institute that are paid by institution funds.



Centers within the ISS include the Center for Nanophase Research – of which I am the director – and the Shell Center for Polymer Center, of which I am also director (I will talk about both of those in more detail later). Then we have the Center for Coatings and Biobased Technology, the Waste Minimization and Management Center, and then the Nanoparticle Application Center, which I will talk a bit about at the end of my talk.

The Center for Nanophase Research. I cannot avoid talking a little about the kind of research we do, so bear with me. We do nanoparticle synthesis, surface modification, synthesis of polymer/nanoparticle nanocomposites, nanoscale self-assembly (we are getting into nano wires and nano-scale memory with that work), nanocomposite characterization, and we do a lot of work with molecular modeling or computational methods to model some of these systems to help direct our research efforts.

Now on cooperation with industry, we have several different modes that we can work with industry. One is just contract research, where the industry comes to us and they say we want task A through B done, and they send us a certain amount of money, we do that task and, in that case, any intellectual property that comes out of that belongs to that company because we are not actually doing research.

Then we have the more traditional research grants, where the company will actually give us a grant to conduct research in a certain area. In those kinds of agreements the university on the front end works out an intellectual property agreement, and generally those take the form of the company having a non-exclusive license to use any IP that comes out of that research at no charge. But that is non-exclusive. If they want an exclusive license, then the university will retain a negotiated license fee and royalty associated with that. I have a fairly interesting grant that we worked out with one company, where the company agreed that anything that was commercialized out of that research, the principle investigator would get directly a US$25,000 bonus for creating this new technology.

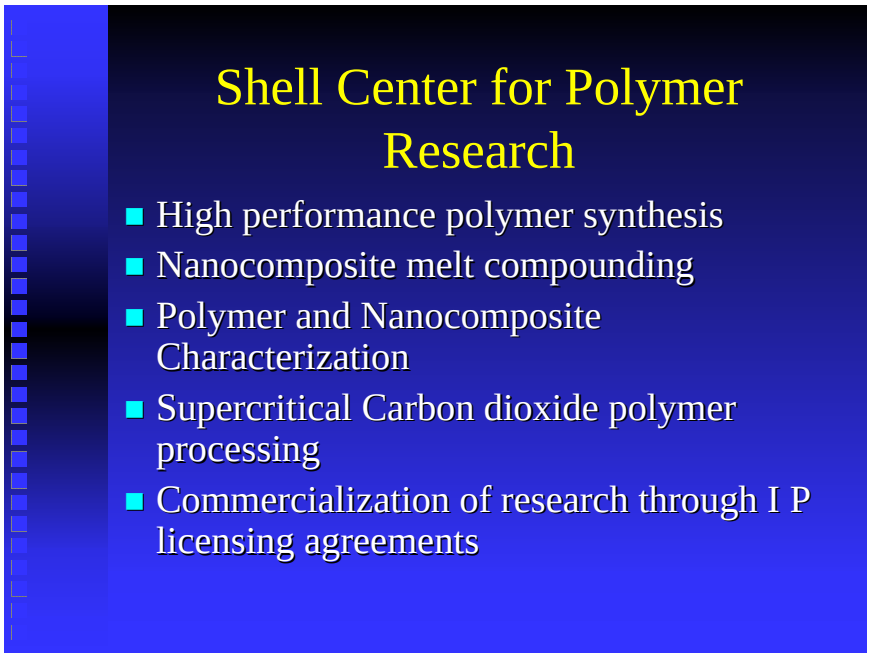
The third thing that we do is small business innovative research. In the United States we have this program that the government will set aside certain amounts of money for small entities to do research. What we

mean by small entity is companies with less than 500 employees. We are very active in cooperating with a number of companies in these small SBIR sorts of endeavors. Those endeavors can be very viable ways to develop and commercialize new products. Generally those programs are divided into three phases. The first phase is only about six months long. You get a total of US$100,000 to do research over those six months, of which the university gets about one third. But when you get into phase two, which is going in to more of the pilot scale and a little bit more of the commercialization-end of things, you can get monies in the range of US$200,000-250,000 for the university. If you can get through that phase one, which we have done in two or three cases, it can be a very good way to support your research at the university. We have a suite of companies that we work with on a regular basis on these SBIR programs.

Now the fourth thing we do that is very critical – I do this very heavily in my group – is I have the students spend at least one summer during their time with me doing an internship at a company. This is fairly unusual for a chemistry program. It is not so unusual for engineering programs. Just about every one of my students will spend at least one summer actually working in the industry that they have been doing their research with. That has a number of benefits. One, it really helps the student focus on whether industry is really what they want to go into, because they spend a summer actually doing research, but also at least 50% of the students that do these things end up taking a job at the company where they did their summer internship, so it is a very good way to place your students into employment.

We also have visiting research scientists. We can have scientists come in from industry and spend whatever amount of time they want to within our laboratory. In fact, right now we have one research scientist that is spending pretty well full-time in our laboratories doing research with our group. We also have cooperative research at industrial science. We have a number of companies that are in the area where we go to those industrial sites on a regular basis, and conduct research using their equipment and facilities to do research. Generally, with most of those, the industry has actually given us money to support that. But they have also opened their doors to allow us to use their equipment and facilities. We also have a major effort in IP commercialization. We try to really push anything we actually apply for intellectual property on to commercialize it. In most cases, that is very easy because we are working so closely with the industry that the commercialization comes very naturally, and it is pushed actually by the industry.

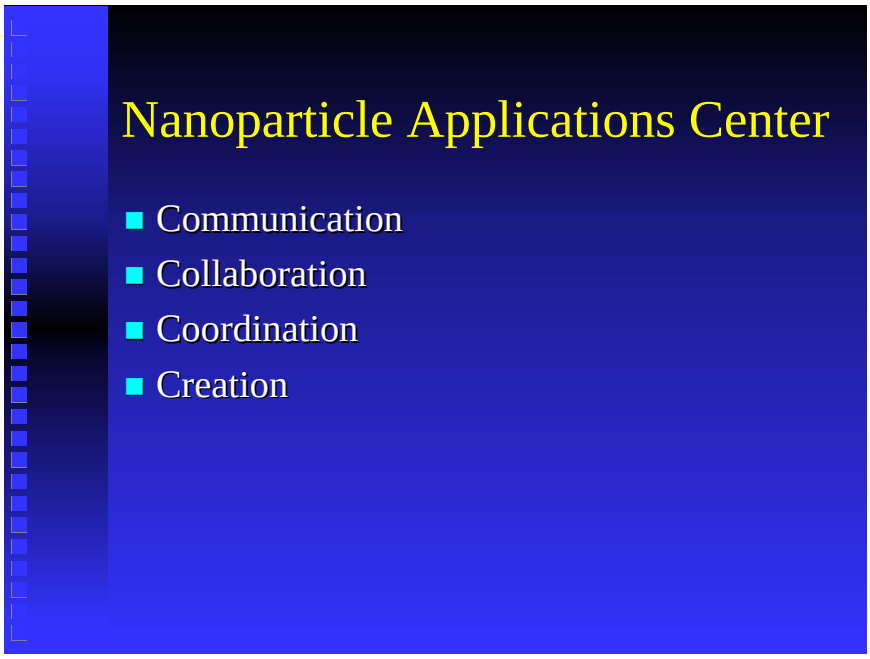
This is just a list of some of the current industrial folks that we work with. A lot of them are pretty common or are well-known to people.



I will shift gears – another center that we have within the IIS is the Shell Center for Polymer Research. We do high performance polymer synthesis, nanocomposite melt compounding, polymer and nanocomposite characterization, supercritical carbon dioxide polymer processing. But one of the things we are heavily involved in is commercialization of research through IP licensing agreements.

Shell Oil Company decided to get out of the polymer business, so they went around to a quite a number of universities to see who they would give their intellectual property portfolio to. So the competition was between about four schools in the state of Texas. We actually won the competition and they have donated about US$8.6 million worth of intellectual property to our university. Along with that, we negotiated a research contract, or grant, that they gave us to help us to do further work on those particular patents to make them more attractive to industry to license. In one case, we are working for GE Plastics to commercialize one of those patents, to generate a revenue stream for the Center and support its efforts in the future. We are starting to do the same thing with the second batch of polymer patents that they have given us. We are being very aggressive at trying to get out there and license that technology and support that licensing effort with further research to direct it very specifically to the needs of industry that might license this technology.

Now, the Nanoparticle Application Center, which is the last center that I will talk briefly about. You can see the mission of the NAC, and I believe that we handed out brochures to a number of you about the Center.



On the next slide, I put down the four Cs. The Center is attempting to improve communication about nanotechnology, in Texas first and then throughout the world. We look around the state of Texas, and we have a lot of nanotechnology research going on. But there is not much coordination between the different centers where research is going on: UT, Texas A&M, University of Texas at Dallas, Rice, Southwest Texas State, UT San Antonio. So part of our function at the Center is to communicate between all of those entities and outside the state as to what is going on. We also want to foster collaboration between all of the entities within Texas, to create something that is more than the parts – that the whole really becomes something much greater. We also want to act as a coordinating factor, to coordinate some of those activities, and to coordinate education and seminars in the area – we have a very active program to support regular seminars in the area. But ultimately, the last one is the most important: we want to create jobs in industry that support people. Ultimately, all the other things should funnel right into that last one of creating new industry and new jobs.

So I will stop there and open it up for questions.

Mr. Konagai: In your university, the character was changed from education to research. You are in the process of changing from education to research in your university. For that kind of – how shall I say – change in character, what are the steps in determining the change of characteristics of your university? I am interested in that. In the case of Japanese universities, changing the character of a university is very difficult, and there are all kinds of professors that would object to that. Did the government direct you or did the university professors take the initiative of changing the character of the university? If the answer was that the initiative came from the university professors, then in persuading other colleagues, how did you do it?

How did you convince and persuade other university professors to change the character of your university?

Prof. Beall: Changing our university was really not directed by the state, it was mainly directed by our previous president. He started organizing the university such that the reward system was oriented more and more toward research faculty rather than teaching faculty. Now there was great resistance to that from some of the teaching faculty. That still is ongoing today. However, the momentum of change has reached a level that I think most of the teaching faculty realize that they cannot stop the change. Another factor that was very important was bringing outside funding at a very high level into the university. The hiring of new faculty was oriented on bringing new faculty and that had that orientation. We are not there yet, but we are well along that path. But it has not been easy.

Mr. Konagai: One more question, if I may. Now you have created new research centers. In order to make centers more competitive, you have to have professors and you have to have excellent students, you have to collect them for the sake of competitiveness. Did you introduce any particular means to do that? UT Austin, Rice? You have a lot of rivals in the state of Texas. How do you manage this competitiveness issue?

Prof. Beall: There are ways. One thing that has helped us is the fact that the overall population of students in Texas is rising very rapidly. The University of Texas and A&M both have kept their enrollment. We have benefited by having many students that just could not get into the University of Texas or Texas A&M that have come our way. So that is one factor. The other factor that we have done – and I do this quite regularly in my group – is we home-grow our students. I start at the freshman level, identifying very promising students and convince them to do undergraduate research. Then, the best students I convince to stay for a Master's degree. So some of that you can do home-grown. But the demographics of our student population have helped us do that. If we had to compete directly with University of Texas or Texas A&M, we would have a very difficult job doing that. But because they have kept their enrollment, it has worked very well for us.

Mr. Konagai: I have a question with respect to overhead cost. In the case of universities in the United States, the overhead cost is about 60%, and you said that at a three-tier university it is 46%. Whenever we have industry collaboration, it comes down to 15%. How does it make it possible? Does it mean that if you have more contracts, then it will end up being the same level or do you receive some support from the state? Can you elaborate on this point for me please?

Prof. Beall: We do not receive any subsidy from the state. As the administration realizes that there is money there that they could possibly tap into, the situation on overheads will change. Right now we are enjoying the very low overheads. But when administrators start looking at all these millions of dollars coming in and they are only getting a certain amount, I am sure they will raise those numbers. We will take

advantage of that as long as we can.

Mr. Konagai: Chemistry major students, they go on summertime internships. I was very much interested in that program. I would like to ask you this at some later time, but students going to a different environment and continuing research activities, I think this is very important. Regarding nanotechnology, chemistry should play a very important role, but in Japan, this concept is not shared by a lot of people. My question is that for the internship, do they go to chemical companies, or do they go to engineering or mechanical or photonics companies? Where do they have internships?

Prof. Beall: In my group, most of the students have gone to chemical companies. More specifically, a lot of them are going to polymer-producing companies. The program is very interesting because many times the students, I almost have to force them to go because they are not comfortable with leaving where they live and their environment. But invariably, once they get to the company, within about two weeks they call me up and say thank you so much for forcing me to go because their experience is so enriched by doing the research in the company.

They also make very good money. My average intern makes about US$2,700 a month, plus a housing allowance. They could not find any summer job that would pay that much money, plus they get the experience.

When I first started doing this, a lot of the traditional academic faculty did not think it was a very good idea. They thought I was sending my good students away. But what they found out was when they came back, they were so enthusiastic about research, they were more productive when they came back.

Dr. Yaniv: Gary, can I have an internship this summer? US$2,700? Another question.

Mr. Asada: Earlier, within nanotechnology, you said you were taking an interdisciplinary approach, and I think it is true. I think you encompass a very wide range in area. Unless you fuse all of these areas, the development of nanotechnology cannot be realized. At the Center, you are actively promoting this. Can you elaborate further on the specific approaches that you take in order to achieve this?

Prof. Beall: We really do not have any specific program to do that. As in any endeavor, it involves humans and that personal human relationship is probably as important in accomplishing those interdisciplinary sorts of endeavors as almost any factor. I depend heavily on the personal interaction between the physics professor that I work with and myself or the person in technology. It is really driven by being a champion for technology and pushing that on a personal basis.

Dr. Yaniv: Let us thank our speaker once more.

Now we have 20 minutes for discussions. You can ask our speakers whatever question you could not ask during the program.

Mr. Asada: This is related to the presentation we just heard. When there is so much research in universities, and when it increases, I think that in industry, the companies are also providing information to the universities as well. But then, as it was mentioned earlier, when there are more and more companies coming in, then the relationship with the companies become very difficult. What do you do about isolation of intellectual property? Are you going to satisfy a role, or do you think that because it is so common you would not put up such barriers and you would not mind that? That is what I would I like to hear about.

Prof. Beall: What we are trying to do is when we have an industrial client come in, we try to make sure we do not have a direct competitor of theirs working with us. Now, so far we have been able to do that, but there will be a day when we will have more than one company coming in working in the same area, and we will just have to work on that when that occurs. We have tried to partition things such that we do not have companies competing directly that are funding our research.

Dr. Yaniv: Would you like to add something regarding intellectual property matters?

Dr. Ronstadt: Yes, I would like to respond in terms of the life sciences and human testing. We have quite a bit of activity going on in our campus now to develop guidelines for conflict of interest. When you get involved obviously in pharmaceutical testing and human testing, it is very sensitive. This is what we called a double-edged sword because if you do not develop certain guidelines then inevitably at some point you are probably going to get into serious trouble. On the other hand, if you design them so stringently, you end up stifling innovation. You can make sure that there is never a conflict by designing those rules so tightly that very little innovation occurs, and we have seen this at other universities. We are trying to avoid it.

Dr. Yaniv: Other questions, please?

I have a question. My question is I would like to hear your opinion about the role of the university professor as an entrepreneur. As a result of that, education does not suffer from one point of view, and from the other point of view, if professors trying to be entrepreneurs do not basically damage real entrepreneurship, but people did not know how to do entrepreneurship… Can someone clarify this question?

Prof. Beall: Well, I will hazard a guess. I think you are saying, should professors become entrepreneurs?

Dr. Yaniv: Exactly. For example, the gentleman from the University of Tokyo said, and also Unlu said, yes, after we do what we do, then we want to create companies and all this. This is the function of a professor?

Prof. Beall: I have had personal experience with this because I was a tenured professor for approximately 12 years. During this time, I was running some businesses – what we call sideline businesses. I was continuing my academic career but also starting businesses. Eventually the businesses grew and grew. I went out and sought venture capital and raised several million dollars. All of a sudden, I had very serious investors involved, and you have to say, well, am I going to continue my academic career or am I going to have to realize that I have got a serious responsibility with investors who have put a lot of money into this business? I ended up leaving academia for a number of years and pursued a software venture.

My own experience was that it was not a good thing. It was not a good thing because while I had certain entrepreneurial instincts, I could not, quite frankly, overcome my training. My training to analyze, my training to theorize, and when you are an entrepreneur you can not be doing that. You need to sell. You need to make things happen and move, and if you are continually self-analyzing things, then I think you get into a problem.

My experience relates somewhat to the experience that other professors have in other universities. The sense that we had in experience, partly, at Boston University is that the professor's comparative advantage is to remain a professor, but find a way that they be involved in their ventures. They can be involved as a board member, they can be involved as a team member, but they do not necessarily have to be the lead entrepreneur engaged in this activity full-time. Better to start 10, 20, 30 ventures and be a board member on all of them rather than devote all of your time to one venture.

Now having said, there are always exceptions, and you can point to them, and others know of people, like Ken Olsen who left academia, or had degrees and went, and it was very successful. But I think on the whole we try to figure out ways to discourage them.

Dr. Yaniv: You are perfectly right. In my talk later on, my analysis shows that professors that are entrepreneurs basically destroy the chance of job creation because by being entrepreneurs, you are using your students as free slaves. You are using the university facility that is free, and you compete with a poor entrepreneur like me who needs to pay electricity and salaries to people, who needs to find this money, to find a building to heat up, I need to pay for heat. But I create jobs because I hire people from outside the system. Not students. I wish I had students, free slaves, but I do not. By the laws of the state of Texas, I need to pay salaries to feed the people. As a result of that this creates a tremendous anti-job mentality.

I think we should take the example of Singapore. I love to introduce this in America. If a professor wants to start a company, he needs to resign from the university. He needs to make a decision. Does he want the good life of the university with low pay? Or does he want to go out of the university, work 24 hours around the clock and have a very disturbed life, but make money? I think this problem has to be solved; otherwise it will not create jobs.

Dr. Kordzik: Actually, I will not touch upon this in my talk about Rice University, but one of the things they do when a professor develops technology that is going to be commercialized in some way – they sit down with the professor and discuss the conflict of interest issues about their dedication to the university versus their dedication to the company, and define what are the clear obligations that they have, and if their obligations are no longer going to be to the university then they have to leave the university and join the company.

Dr. Yaniv: Hallelujah.

Prof. Beall: The professor's relation to industry is not simply only related to creation of companies, or starting their own companies. It is very important to have industrial collaborations in general, and one key point of that is that it provides relevance. It is easy in a university environment to become irrelevant. You can work on a research topic which industry will never benefit from. To remain relevant, one has to always have industrial collaborations, interactions.

Dr. Yaniv: I entirely agree with that. This is totally true and correct. This is what should be preserved.

Dr. Kordzik: One comment. I heard this from a venture capitalist in Japan. This was a very good implication with respect to venture originating from the university. In the case of the venture company, which is related to R&D, marketing and sales become very important. But they seem to undervalue the importance of the marketing and sales and this leads to the failure of the company, especially with respect to the university professors when they start up a company. He wants to come up with something good for the world, and then he goes into a new research area, and then he neglects marketing and sales. This is the biggest problem. When a university professor starts up a company and leads a company, these two areas are very important. That was a comment that was mentioned by a venture capitalist in Japan.

Dr. Yaniv: Thank you very much. Good comment. Other comments, please.

Dr. Kordzik: Actually, I have a question for those from Japanese universities: How important are the alumni of that university in the direction that the university takes? In Texas, the alumni, the former students,

who are now out there making lots of money and who are being asked to donate a lot of money to the university and fund it in other ways, have a great amount of influence in the direction of the university. I do not know if Southwest Texas, also known as Texas State, they are growing alumni as they become a larger and larger university and have more students. As you can see, they are growing quite quickly. As they have more alumni they will have more say in the direction, of whether or not it is a teaching institute or a research institute. I am from Texas A&M, and the Texas A&M alumni are very strong. There is a billion-dollar capital campaign that is going on. So the alumni of Texas A&M have a very strong influence as to the direction of the university. My long question is, how is the role of alumni in Japanese universities in the direction of the Japanese universities?

Dr. Yaniv: Let me mention that one of the alumni of Texas State is President Lyndon Johnson. In any case, please let us answer the question.

Mr. Konagai: Konagai speaking. I would like to then comment on that question. Well in the United States, yes, alumni have a very large influence over university direction, and we know that through our homework. For example, at MIT, around 20 billion yen or so is contributed by alumni. In the case of other universities, alumni, for example, have created outstanding facilities and universities to allow the students to use them. So they do contribute to bettering the environment and with that students learn more, and as a result of that the students become embedded, feel embedded to the universities because they have been able to use those outstanding and excellent facilities. Therefore, in the United States I do understand and we do all know that you have a very good system there in the United States.

Now, what is the situation in Japan? We do not have that kind of system. Yes, we do have alumni. But for example, will these alumni be able to raise 2-3 billion? No, we have not had that example in the past. That was not possible in the past. From next year onward, universities will be made into corporations and that will become possible. So, we, on our part, would also like to capitalize and leverage on these alumni.

When we think about industry partnership, yes, we do have many graduates from universities working at these companies, so we would like to mobilize and capitalize them for our collaboration or partnership with industry. We are at present in a transition period. Several years down the road, probably alumni will be able to help us. I think that is quite feasible and conceivable.

Dr. Yaniv: Do you have any remarks to this question?

Yes I would like to respond to it because I think it really goes again, back to the issue of the economics of university funding and revenues. We basically have asked a number of questions of the various speakers over the last hour regarding research grants, administrative burden levels. Now we are getting into

fundraising. This all really raises the question of how are you going to pay for a university, and how are you going to pay specifically for technology commercialization activities? Are you going to subsidize it by tuition and fundraising, alumni gifts? Are you going to try to make money off of taking equity in the ventures that comes or that they produce, or licensing income?

My observation or the point is that nobody has really figured it out yet. There is no good business model for technology commercialization that anyone has created. We are at the tip of the iceberg here in terms of trying to figure out how we are going to pay for commercialization and indeed if we should. It is a very adversarial situation. You can offend potential big donors. It is a question, an issue, a strategic question that the people at the very top of the university have to figure out.