Session 1 Education and R&D in University

Strategic Management Systems for Research and Industrial Partnership

Makoto Konagai
Tokyo Institute of Technologies
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Dr. Yaniv: Dr Konagai will talk about strategic management systems for research and industrial partnership, especially showing what happens at the Tokyo Institute of Technology. Prof. Konagai is an associate general director at the Office of the Vice President and the Research Strategy Office of the Tokyo Institute of Technology.

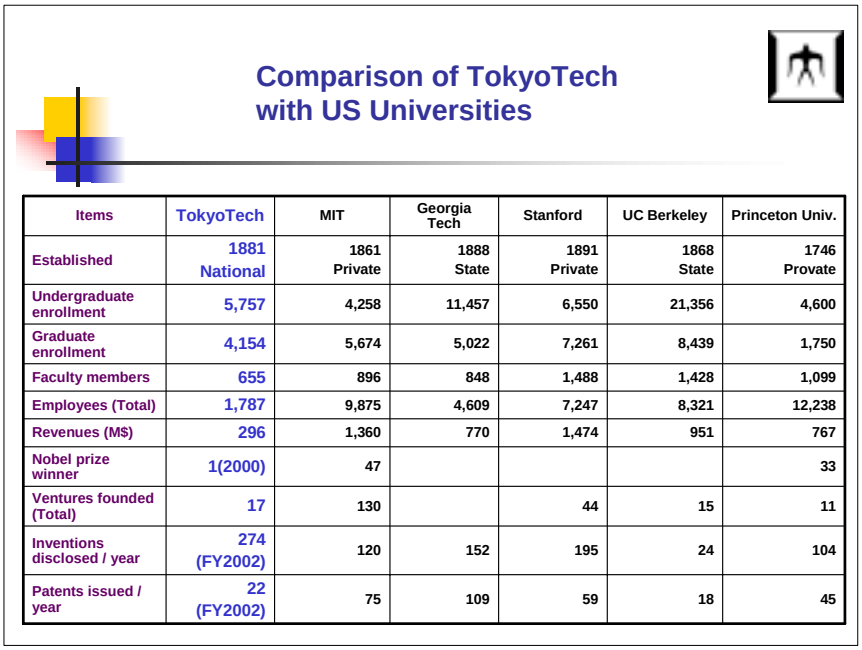
Mr. Konagai: Please allow me to speak in Japanese. My name is Konagai of Tokyo Tech and today I would like to talk to you about strategic management systems for research and industrial partnership.

The main topic of this symposium is education and R&D, but at my university we have not been addressing that systematically. We are strongly interested but we have not gone into specifics. So I would like to talk to you about the current situation and another important issue is how to nurture our doctoral system.

First of all, I would like to talk to you about my university and tell you about the present situation of our education and research. One of the major issues with national universities is that the universities have

become corporations. We are going through university reform. As part of our university reform, our university is trying to structure strategic management systems, so I would like to introduce you to that as well.

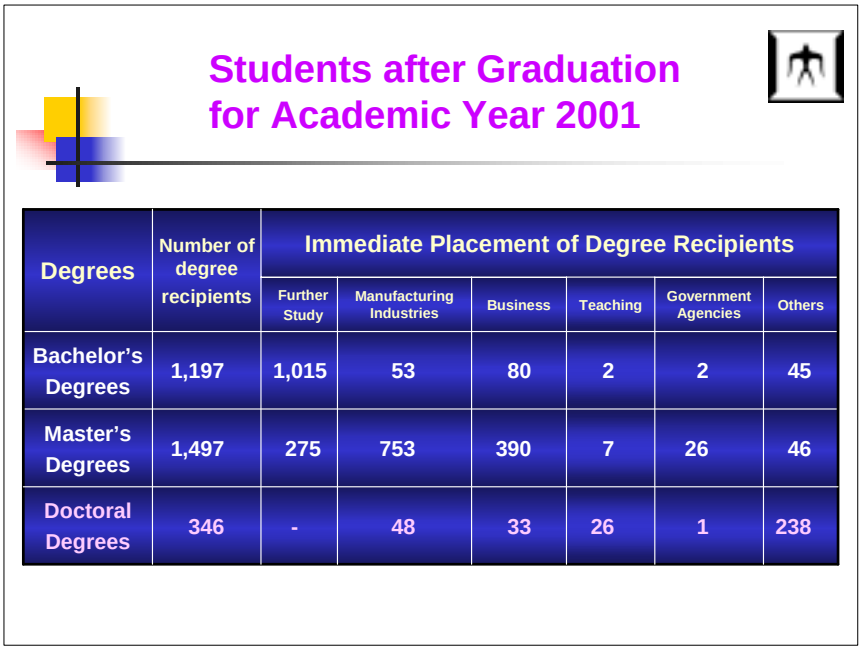
With respect to research, we established a research strategy office two years ago, and this has been instrumental in our activities, so I would like to tell you about our activities. We have established innovative research initiatives and MEXT has a program called the COE-21 Program, so I would like to introduce that to you. The secretariat has also asked me to talk on various topics so I will have to address issues. I would also like to talk about technology transfer, about the inventions as well as MOT. In order for you to understand the doctoral program in the Japanese universities, I would like to talk about what we have been doing at our university and what the doctoral students will do individually after they receive a doctoral degree.



Comparison of TokyoTech with US Universities

Items	TokyoTech	MIT	Georgia Tech	Stanford	UC Berkeley	Princeton Univ.
Established	1881 National	1861 Private	1888 State	1891 Private	1868 State	1746 Provate
Undergraduate enrollment	5,757	4,258	11,457	6,550	21,356	4,600
Graduate enrollment	4,154	5,674	5,022	7,261	8,439	1,750
Faculty members	655	896	848	1,488	1,428	1,099
Employees (Total)	1,787	9,875	4,609	7,247	8,321	12,238
Revenues (M$)	296	1,360	770	1,474	951	767
Nobel prize winner	1(2000)	47				33
Ventures founded (Total)	17	130		44	15	11
Inventions disclosed / year	274 (FY2002)	120	152	195	24	104
Patents issued / year	22 (FY2002)	75	109	59	18	45

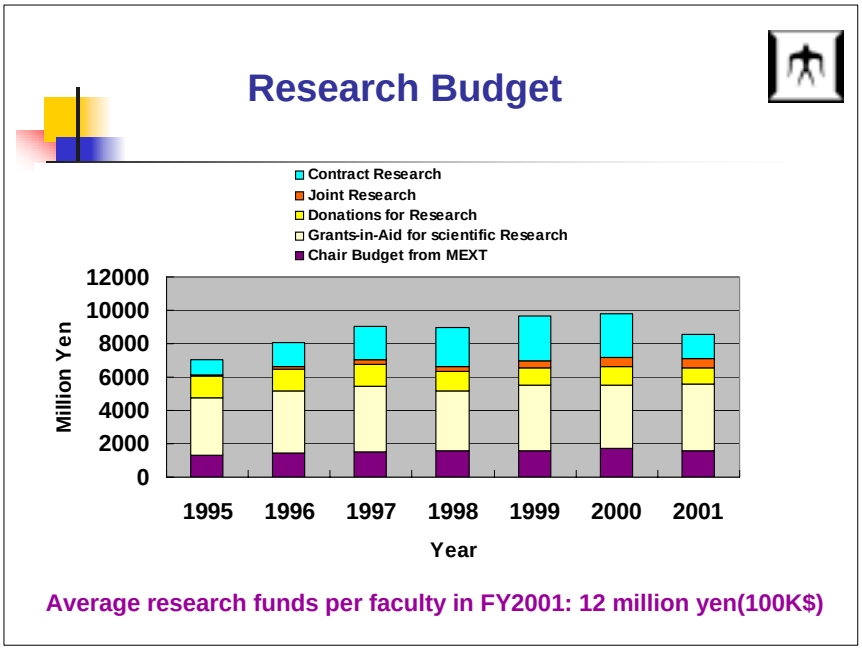
I would like to compare Tokyo Tech with US universities. I have tried to compare universities that are about the same size. We have 5,700 students at our university and 4,054 graduate students. So in terms of students, we are approximately the same size as MIT. As for staff and faculty, we have 655, and MIT has about 900. We have about 1,700 employees and I understand MIT has about 10,000. RAs and TAs are usually included in employees but in our employee number we do not include them. So we should add them but it is clear that we have less employees than MIT, for example. We would also be interested in the ventures founded and the inventions disclosed as well as patents issued. So I will be mainly focusing on all these topics.



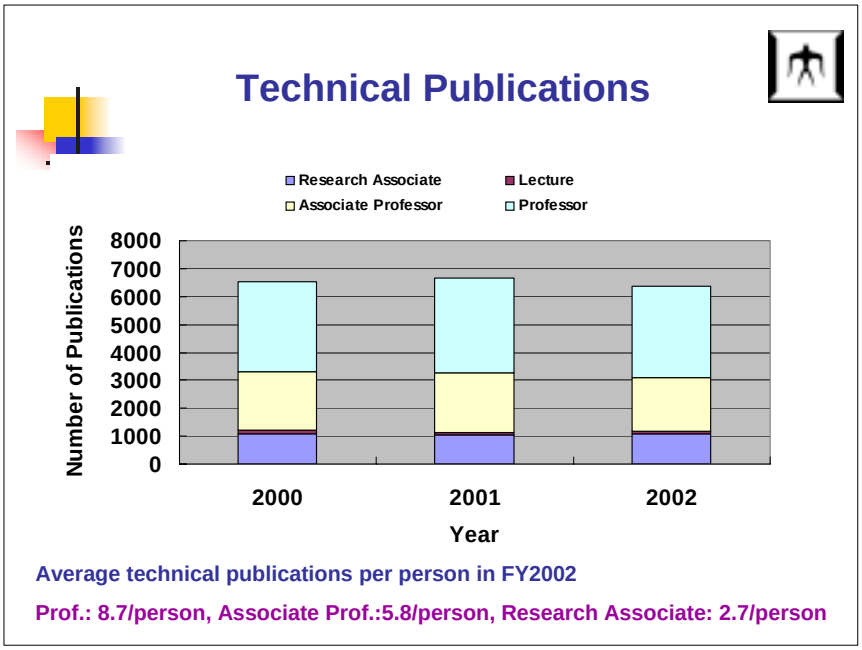
Degrees	Number of degree recipients	Immediate Placement of Degree Recipients					
		Further Study	Manufacturing Industries	Business	Teaching	Government Agencies	Others
Bachelor's Degrees	1,197	1,015	53	80	2	2	45
Master's Degrees	1,497	275	753	390	7	26	46
Doctoral Degrees	346	-	48	33	26	1	238

Next. After the students graduate, where do they go? The secretariat has asked me to introduce that to the audience. This is the number for the academic year 2001. After they graduated, where did they go? Approximately 1,200 students graduated, but most of the students went on to get a Master's degree, so about 85% went on to the Master's program and very few actually get employed. We had more Master's degree graduates (1,500 approximately) and of those who got their Doctor's degree, only about 20% of those received a Master's degree. The remaining students went into the manufacturing industry.

Now, as for the doctoral degree, 346 received a doctoral degree and 48 went into the manufacturing industry. I think the number is very small. So where else do they go to? They go to others; in other words, they go on to a post-doctoral degree or they may go overseas. So you find out that very few go into the manufacturing industry. This is for the entire graduate school. So the school of engineering could be little different.



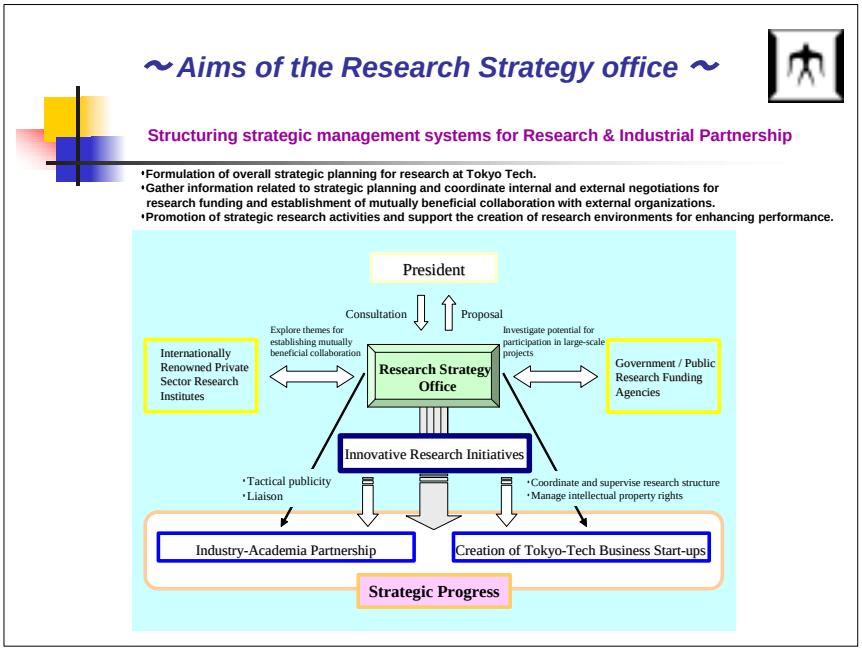
Now let us look at the budget. This is the research budget for the entire university. At the top we find contract research from the government as well as from the private sector. We are focusing on the red portion, which is joint research. This is joint research with corporations. You will find that it is surprisingly small. So the university would like to increase its joint research with corporations. So I would like to talk to you on that as well. In Japan, we have a donation for research. This is the yellow portion. This is the donation we received for research. We have less and less donations that are free. So we would like to increase more joint research. This portion is the grants and aid for scientific research as well as chair budget from MEXT. These are to be used for R&D so I should have excluded this from this chart. But if you add them all together, the average research fund for a faculty is approximately US$100,000. I do not think it is very small.



This is the statistics for technical publications, not only for technical publications, but it also includes publications at international conferences. So this is the total of our technical publications by research associates, etc. In fiscal year 2002, professors would publish on average 8.7 publications per person.

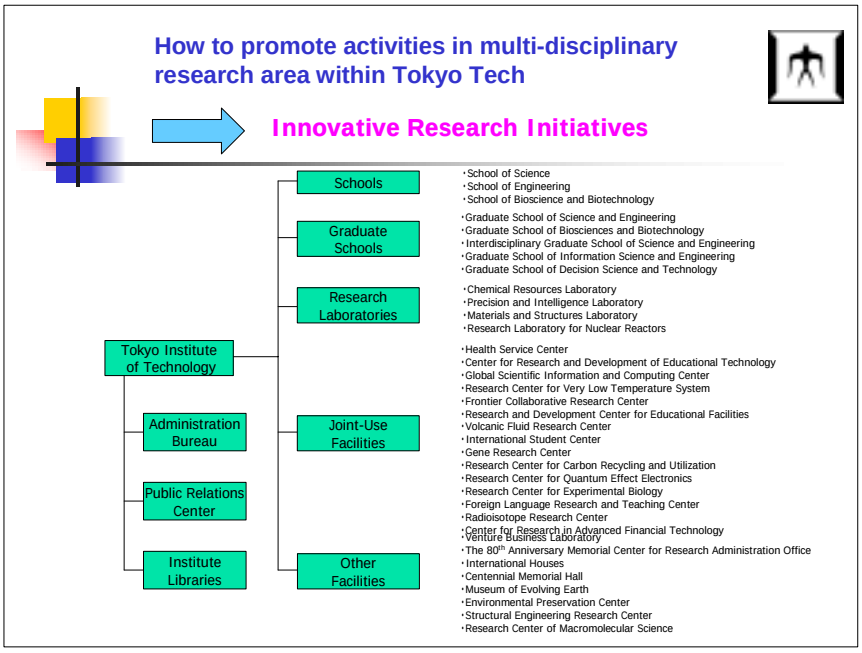
Next, I would like to talk to you about the university reform. The national universities in Japan will be transformed into semi-autonomous entities from April 2004. It is not going to be that they will be totally autonomous. They will be liberated, about 50%, from government restraints, so various universities are

trying to devise their own guidelines and rules. So far, they have been under government control but they have to become autonomous. We will have to advise them on all aspects, but the most important thing is how to carry out industry-academia collaboration. Prof. Aizawa two years ago became the president of our university, and at that time he had established various offices – a research office, an international office, an evaluation office and an educational planning office.



Under the instruction of the president, we have tried to address various aspects from the strategic standpoint. I am the associate director of the research strategy office, so I would like to introduce to you this research strategy office. Now this describes what the research strategy office does. Under the instruction of the president, we carry out all sorts of things with respect to research and we make proposals to the president. The most important role is that in the past, we received contract research from the government, and everything was done individually, but we wanted to address them strategically from the university standpoint. So we would grasp the content of the research and carefully screen it so that we could come up with good results. The major topic is how to carry out academia and industry collaboration, and we have established innovative research initiatives. I do not have the time today so I will not be able to talk to you about the creation of Tokyo Tech business startups.

Now let me elaborate further. At Tokyo Tech, we have very famous professors in this area and individual professors stand out. However, as a group we do not stand out. So we would like to agglomerate all the powers of the individual professors, so that we can enhance our activities. There are various multi-disciplinary research groups and we have various professors in many departments, so we would like to combine everyone together. When we were thinking about this, MEXT established a 21st Century Center of Excellence Program. Not only in education, but I though it was a good opportunity to bring all the professors together, so we are really addressing these two points.



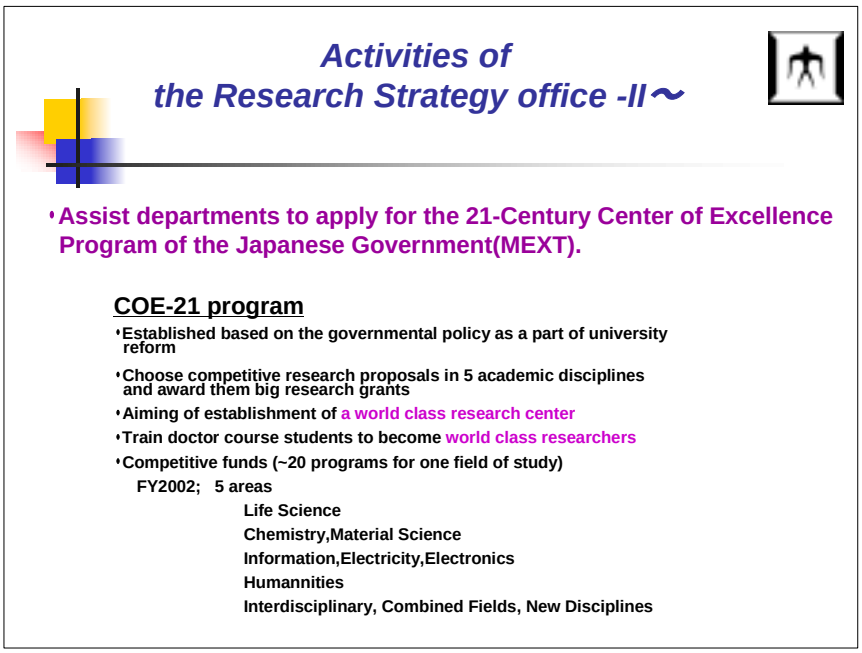
This is too busy, so I hope that you would take a look at this chart at your leisure.

We have five graduate schools that carry out research and we have four research laboratories, and there are various other centers. Various faculty members are carrying out all sorts of things so we would like to try to integrate that.

Field(Priority Area)	Selection of Innovative Research Initiatives
1: Life Science	・Study Program on Brain Informatics at Tokyo Institute of Technology ・Drug Discovery Research Based on Reverse Proteomics
2: Information Technology	・Quantum Dot Devices ・Optical Node Technologies for Ultra-high-capacity Signal Processing in Future Lightwave Communications ・Human-centered Information Systems for Ubiquitous/Network-computing Environments
3: Environment	・CO_2 Mitigation Technologies Combined with Highly Efficient Fossil-fuel Utilization and Sequestration ・Grid-based Global Environmental Simulator
4: Nano-Technology & Materials	・Development of New Industry Based on Ferrites ・Nano・Micro Machines and NEMS・MEMS ・Research Project on Nano-fiber Technology ・Nano-Photofunctional Materials Based on Organic, Inorganic and Composite Molecules
5: Energy	・Decentralized High-Efficiency Energy Conversion System using Fuel Cells ・Innovative Photovoltaic Power Generating Systems
6: Manufacturing Technology	・Super Mechano-System: New Robotic Technology by Fusion of Control and Mechanical Disciplines ・Research and Development of Plasma Processing under Atmospheric Pressure
7: Infrastructure	・Monitoring of Structural Integrity and Smart Material Structures ・Risk Reduction Technology against Urban Seismic Hazard

We have Innovative Research Initiatives (IRI), which was established last year. These are important

interdisciplinary themes that were selected and if there are faculty members that are related to certain areas, we want to combine them so that they become visible. I cannot list all 53 IRIs, so I have listed some of the major ones. We have 8 priority areas that have been established by the government. In each of these areas, we can list some of the studies that have been done at Tokyo Tech. These are in line with innovative research initiatives. With, let us say, development of new industry based on pay rights, for example we would have ten faculty members and professor from engineering and life sciences, all of these faculties will combine together to form an organization. It is not just that we should have an organization, we should appeal externally. We have a very voluminous brochure and we will try to sell them to corporations so that we can appeal to the corporations what we have at Tokyo Tech. We have been very active since last year.



Another thing is the 21st Century COE Program that I mentioned. This is that a world-class research center must be created in Japan. That is the objective. MEXT, the Japanese government is providing a budget, and this program began last year. The academic area is divided into 10 fields, and for each field, 20 would be selected as centers and then priority emphasis will be given to them. So 10 fields times 20 centers means that together 200 such centers will be created. In five years, solicitations have been made, and to these solicitations Tokyo Tech positively and strategically responded and we applied to the solicitations. Last year in 5 areas, as listed here, public solicitations were made and I will show you the results. So a large sum of money came.

This is going to be a world-class research center and at the same time it is going to be an educational institute for the doctoral degree. So in each group, how can we educate doctorates? That is the way the money should be spent. That is the instruction from the Ministry of Education.

The 21st Century COE Program

-Number of Selected Programs (2002)-

	University	Grants (Million yen)	Number of selected programs
1	Kyoto Univ.	1,958	11
2	Tokyo Univ.	1,853	11
3	Osaka Univ.	1,256	7
4	Keio Univ.	931	5
5	Tokyo Tech	751	4
6	Tohoku Univ.	727	5
7	Nagoya Univ.	716	7
8	Kyushu Uni.	650	4
9	Hokkaido Univ.	579	4
10	Waseda Univ.	562	5

113 projects from 50 universities, which includes Tokyo Tech's 4 research projects.

The COE program is going to be expanded in FY2003 in another 5 academic fields.

This is the result of last year. Our university in terms of university scale is rather small, so we did not obtain a lot. But for the four projects we passed, we got this amount of money and we are promoting the bulk of that. Kyoto University and Tokyo University have received more than 10 center designations.

The 21st Century COE Program

-Outline of Selected Programs –

(2002-2006)

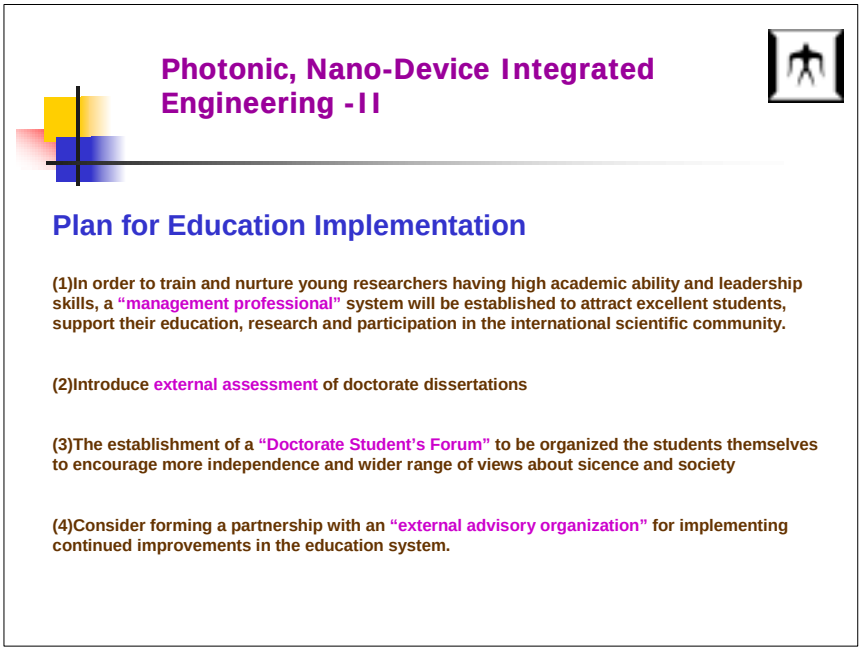
- Frontier System of Bioengineering
- Creation of Molecular Diversity and Development of Functionalities
- Nanomaterial Frontier Cultivation for Industrial Collaboration
- Photonic, Nano-Device Integrated Engineering

(2003-2007)

- Nanometer-Scale Quantum Physics
- Innovation of Creative Engineering through the Development of Advanced Robotics
- Formation of International Frontiers in Urban Earthquake Engineering
- Innovative Nuclear Energy Systems for Substainable Development of the World
- Systemization and Application of Large-scale Knowledge Resources

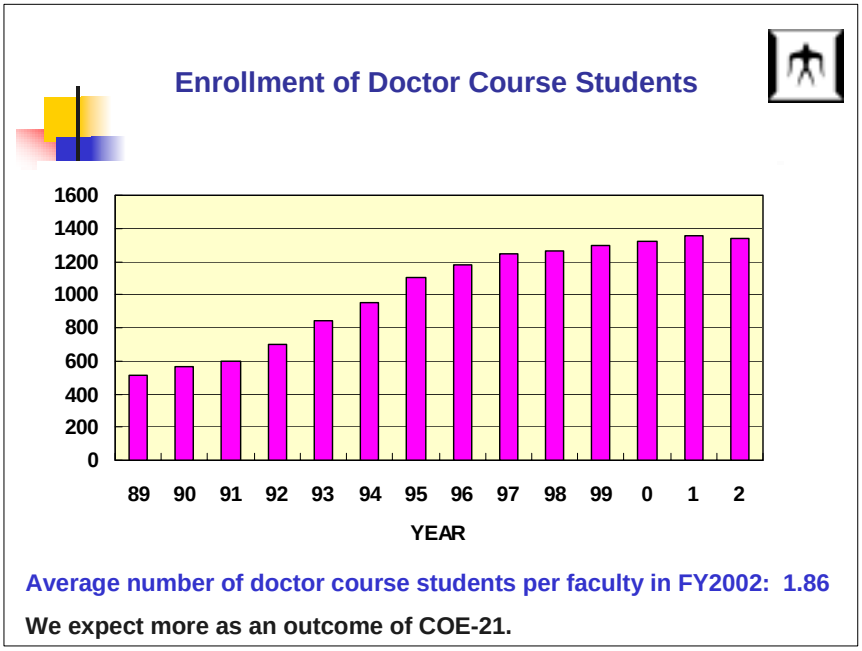
In fact, what I showed is last year, and this year again from the Ministry of Education, again, the public solicitation was issued. Last week it was publicly announced. This year, again additionally, in five areas our university was designated to be a center. So all together, there are five areas where Tokyo tech is promoting

our research activities. This will continue for five years, so this will continue until 2006, and the other lower five will continue until 2007.



It so happens that I happen to belong to this particular group of photonic nano device integrated engineering, so in a concrete way, especially with respect to the education of doctoral students, what is our approach? I would like to explain to you about that. Objectives, as I have describing to you, are to prepare world-class equipment and research environments. In order to do that, what should we do? There are two

aspects: research aspects and educational aspects. What I wrote here is, on research, what should we do? Well, photonics. Tokyo Tech is very strong in this field. But if you look into the areas where professors belong, they straddle various fields and they straddle two graduate schools. So there are five departments which are joined together in creating this center. That is the idea that we currently have.



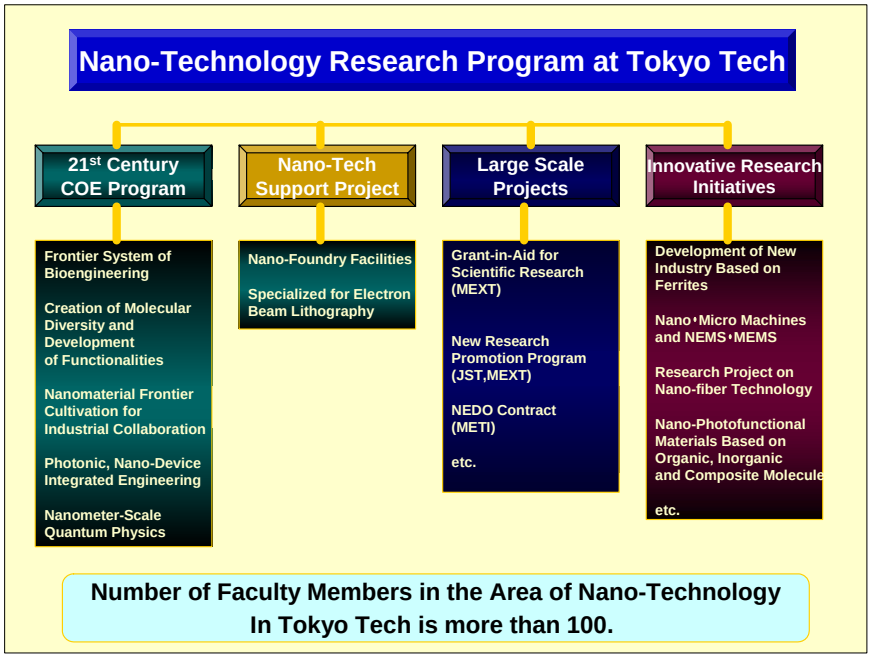
Well I will skip those. We will go on to the education aspect. How should we manage the doctoral students? We are proposing several items and they are making progress. In the eyes of the overseas participants, you may think that they are natural things taken for granted. But in Japan these are things which are difficult to implement.

First point: in order to train and nurture young researchers that have high academic ability and leadership skills, they have to be motivated, the Ph.D. students. They are used to having a one-on-one relationship with a professor and they have not looked at other ways. Their perspective has become very narrow from the past way of doing things. But in this program, experienced company executives will be invited and a professional management system introduced. He or she will instruct the students. Of course there will be the tutor, but there will be an additional professorial person who will guide the student. Then we will introduce an external assessment of doctoral dissertations. In the past, we did internal evaluations only, but since last year we have been introducing external assessments, including overseas professors assessing doctoral dissertations. I think it is done naturally in overseas countries, but at long last, Tokyo Tech is beginning to do something like this.

Point three is similar. Doctoral students tend to be confined to research labs. So we want to open them up to

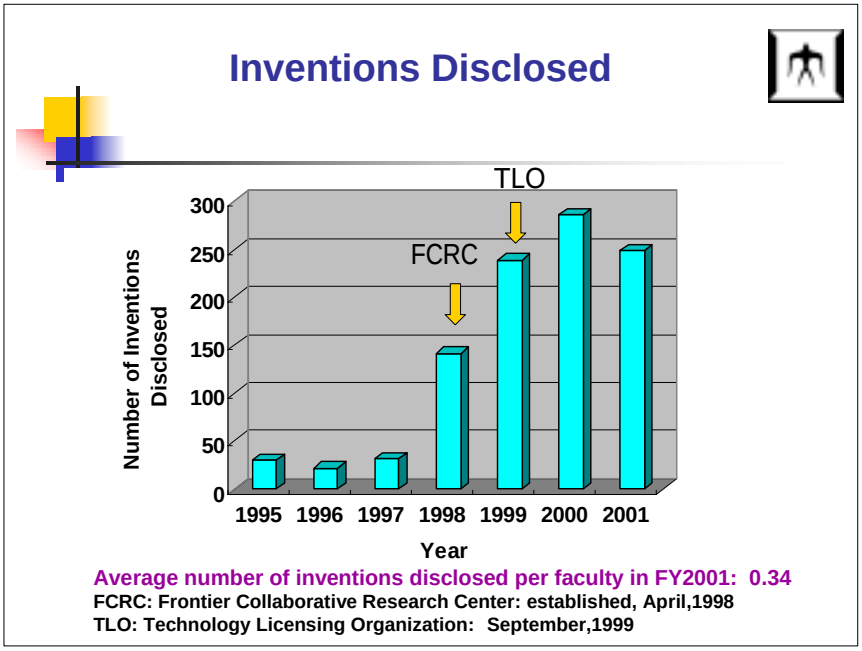
horizontal exchanges. So all together in a group, we have 80 or so students, doctoral students. So in order to have horizontal exchange, a doctoral student forum will be created so that they can liaise with other peers and colleagues.

Through the 21st Century COE program, there are two things that we are expecting. One is simply that we want to increase the number of doctoral students. This is the graph showing the enrollment of doctoral course students, and here it is more or less saturated and it has leveled off. In the case of Tokyo Tech, per faculty member, 1.86 is the average number of doctoral course students. We want to increase that number. In certain areas, this average number becomes different. In the case of bioscience, the number of students is very high. But in the other areas, the number of doctoral students is very small. So we want to review doctoral course education, we want to make it more attractive, we want to increase the number of doctoral course students. At the same time, company people usually say that Japanese Ph.D.s are not usable. So we want to overcome this shortcoming and we want to grow the reputation that graduates of Ph.D. are really usable and valuable.

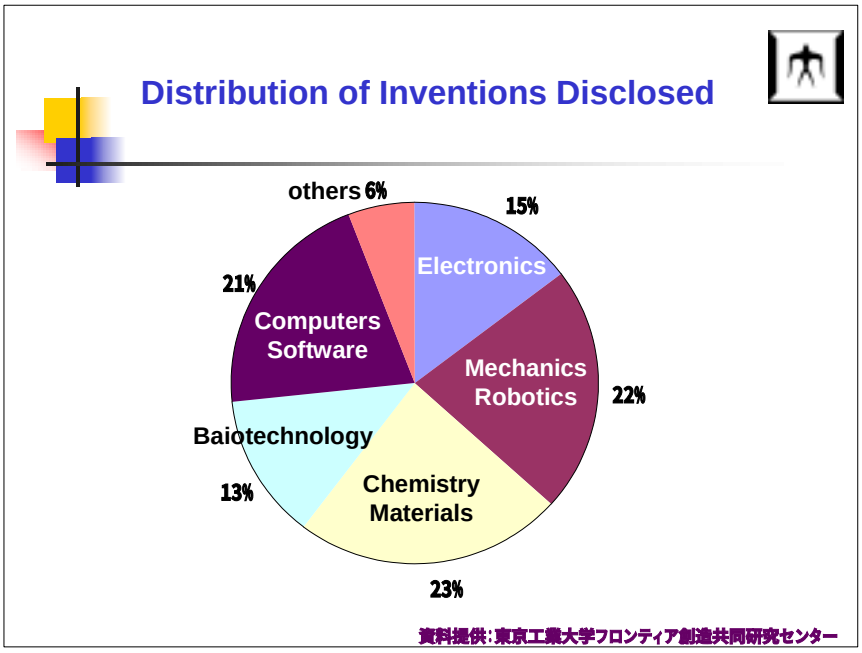


Changing the topic a little, I have introduced to you two major topics that we are carrying out in the Research Strategy Office. So you see professors will de-spread within the university organization, though they are now straddling many different fields. We are trying to integrate all those people. Now nanotechnology is another approach. Actually at Tokyo Tech, there are more than 100 professors related to nanotechnology but they are existing in a disparate way, a diffused way. So we want to integrate them. First is the Innovative Research Initiative, IRI. I could not write everything so I will just mention four points. So there is the Innovative Research Initiatives and then for many fields we can have an integration of efforts.

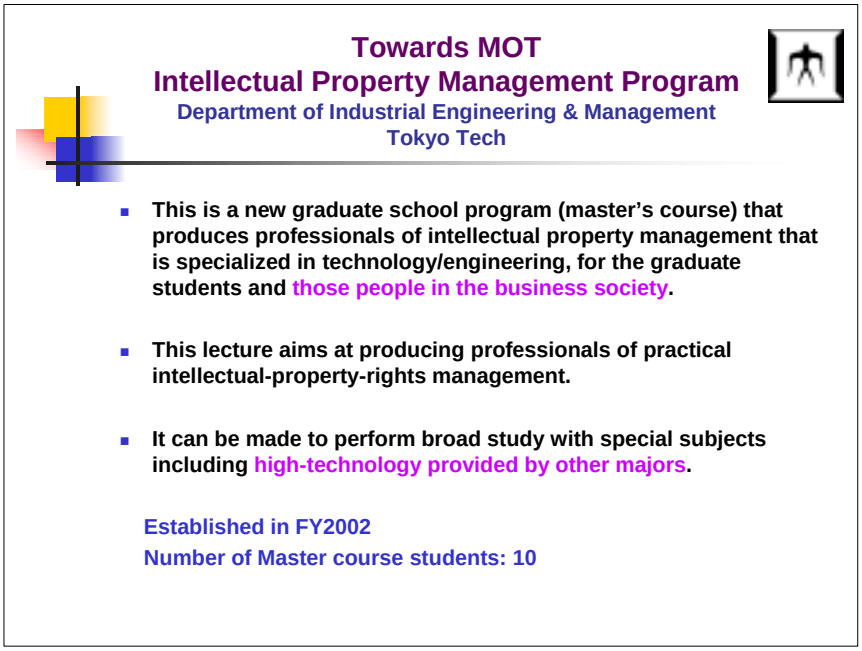
Then with the 21st Century COE program, not only research but education can be integrated as a group, and we will work with the outside world, and as an organization an easy-to-understand approach should come.



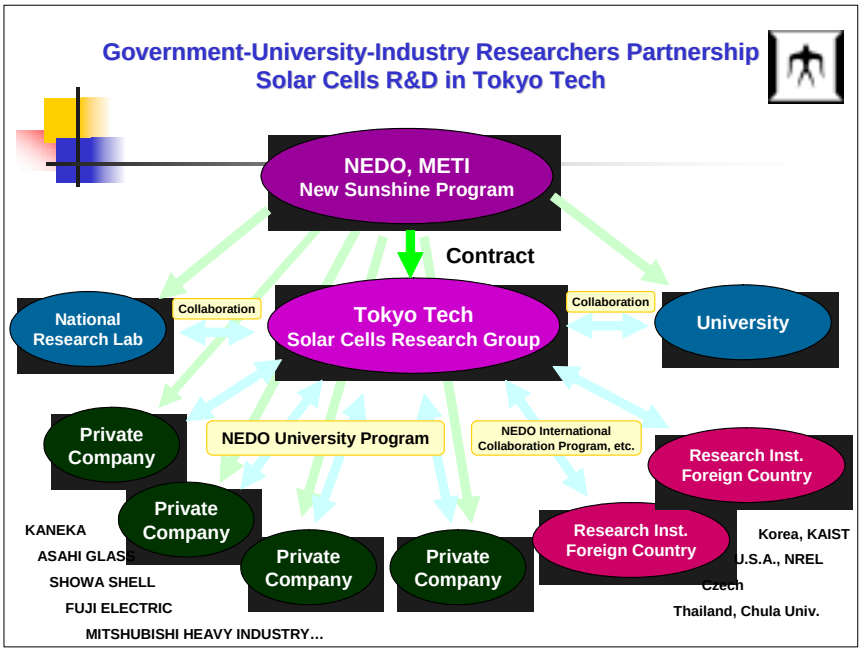
Time is running short, so I would like to show you some data in relation to the partnership between academia and industry. Inventions disclosed: from 1998, all of the sudden there was a jump in number and recently 250 inventions were disclosed. Why did the earlier years have low numbers? Actually, university professors may make inventions. In the past, by and large, university professors were very lazy and they asked the corporations to file an application on their behalf. So actually, for the database and calculations, all the work, the university professor's contributions were great but they did not do anything. Why was this the case? Because there was no supportive infrastructure for the professors and professors were not aware of the value of their measures. That is why the number was very low. But in recent times, at Tokyo Tech, the Frontier Collaborative Research Center was created, so this is doing enlightenment activities. Awareness activities are going on and university professors are willing to file an application for inventions. So inventions disclosed in what areas?



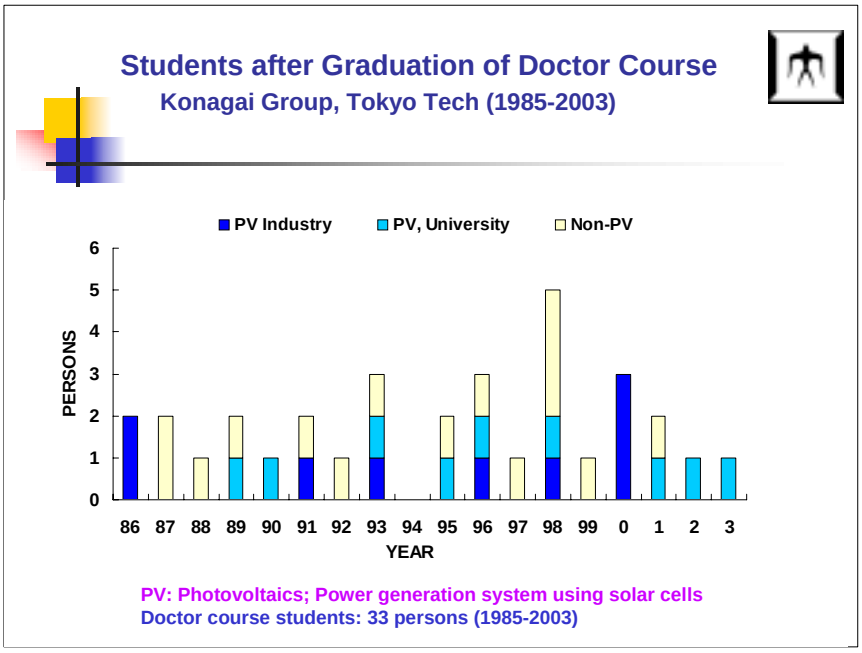
This pie chart shows you the distribution of inventions disclosed. Well balanced, but in terms of royalties and whether they making money, it is different story. Biotechnology-related activities are creating a lot of revenue.



Well, in the interest of time, I hope that you will read this page regarding MOT.



The last point – sorry to talk about my personal things. Today's topic is education and R&D. So in fact in educating students, especially doctoral course students, regarding how we did it and what has come out of that as a result, I have two data. Personally, I work on solar cells. That is the R&D I do and I have been doing it since 1980. Fortunately, our group, through NEDO and METI over twenty some years, received contract research. This money is not going to universities alone; the money goes to corporations. Again, from corporations re-contract is made to universities. So that creates a kind of community. So I myself have contacted many corporations and established relations with corporations. From these private companies, we received many researchers and research students. Solar cell is a very easy to understand research area; there are many doctoral students who come to my research lab and we enjoy a good relationship.



This is the last PowerPoint: students after graduation from doctoral course (this is post-graduation data; March 1986 to 2003 is the duration). Now for the Ph.D. students under my tutoring, what was the research area? Where did they go? My group, relatively speaking, is working on the solar cell and it is relatively easy to understand. On average, the number of students is greater than other areas, other departments. The blue denotes photovoltaics students who went into the photovoltaics industry and the pale blue studied photovoltaics and then went to university to further their academic career. We are working in the nanotechnology area too. So these are the people who are working on nanotechnology. Fortunately up until now, they worked on solar cells and they either went to industry or university and most of them continued their work on photovoltaics. The breakdown is widely distributed. About 50% would enter the manufacturing industry, but 50% did not want to join the manufacturing industry. They wanted to pursue their academic career and they sought employment in the university.

Something unfortunate of late is that the number of people going into manufacturing is coming down and post-Ph.D.s go to other universities and overseas. So education and R&D was the main topic for the organization. If we heighten our awareness, I am sure that there will be more students wanting to join the manufacturing industry with that expectation. I am looking forward to the discussion which will take place in this session.