PLENARY SESSION VIII

"THE SOCIAL SCIENCES AND SCIENCE AND TECHNOLOGY POLICIES"

SCIENCE AND TECHNOLOGY POLICY AND PROGRAM INNOVATIONS AND THE SOCIAL SCIENCES: THE CASE OF THE ENGINEERING AND SCIENCE EDUCATION PROJECT

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Science and technology development is critical in the drive towards sustainable development and competitiveness of the Philippines. Macroeconomic factors notwithstanding, the country's status in science and technology could very well spell the difference over the long term between a robust economy and a weak one. We are laggards in science and technology in East Asia. This is especially worrisome because our neighbors, especially the Confucian societies, are very aggressive in this regard. While there is some appreciation of the importance and role of science and technology in economic development among our government policy makers in both the executive and legislative branches, the translation of this into sound and workable policies and programs leaves much to be desired.

The development of science and technology in the country involves many aspects. Three critical ones are manpower development, building science and technology infrastructure and facilities, and developing a culture of research and excellence. The Engineering and Science Education Project (ESEP) of the Department of Science and Technology (DOST) is a nationally directed effort at all these. This paper focuses on ESEP as a case study of how the concretization and implementation of science and technology policy is embedded in the social, cultural, political, and institutional matrix of the country. In view of this, insights and lessons from the social science perspective are drawn from the case analysis and on how the interface of the social sciences with science and technology can help improve the design and delivery of S&T policies and programs in the country.

THE ENGINEERING AND SCIENCE EDUCATION PROJECT[3]

The main objective of ESEP is to support technology development for industrialization in the Philippines by increasing the supply of well trained scientific and technical manpower. Its specific objectives are (1) to strengthen engineering and science education in priority fields at selected institutions, (2) to improve science and mathematics education at selected secondary schools, and (3) to strengthen DOST's capacity to plan, manage, and coordinate S&T manpower development programs.

The component of ESEP are as follows: (1) faculty development through local and foreign MS and PhD programs, post MS and PhD fellowships, and visiting professorships; (2) acquisition of books and journals, libraries development, and library networking; (3) acquisition of laboratory equipment; and (4) upgrading of research laboratories in public and private universities including the construction and upgrading of 110 high school science laboratories.

The institutions which participated in ESEP consist of 19 colleges of engineering (5 public and 14 private), 10 colleges of sciences (4 public and 6 private), 110 S&T-oriented public high schools located nationwide, and 15 Regional Science Teaching Centers (6 public and 9 private).

The project was implemented over a six and a half-year period (1992 to mid 1998). It was financed by the Philippine Government, the World Bank, and the Japanese Government through the OECF. The Philippine Government financed the local currency components of equipment procurement and construction and part of the local operating costs of the project. The World Bank financed the foreign currency portions of various project components up to an amount of $61 million while the Japanese Government financed the foreign currency component of equipment procurement and consultancy up to $24 million. The project institutions provided counterpart funds for salaries of substitute teachers, the cost of installation and/or extension of power and water utilities for upgraded laboratories, and some operating costs.

As of December 31, 1997, the ESEP had the following accomplishments:

A total of 5,627 manpower development slots have been filled up, which exceeds the original 5,157 manpower development targets slots by 470. A

[3]This section is taken from the Engineering and Science Education Project 1997 Annual Report prepared by the Project Implementation and Coordinating Office (PICO), Department of Science and Technology.

total of 4,477 scholars have completed their course with 1,150 still in the process of completing their studies. Of those who completed their studies, 4,307 scholars are in-country while 170 scholars studied overseas. Of those who are still completing their studies, 125 scholars are overseas and the rest, 1,025 scholars, are doing their studies in the country.

Out of the total of 319 staff months of consultancy and visiting professorships, 233 staff months or almost 73 percent of the target have been used.

The targeted number of books and library materials is 72,296 titles and the targeted number of journal titles is 569. A total of 72,150 titles or 99 percent of the target and 569 titles of journals or 100 percent of the target have been delivered to institutions.

The project earmarked 1,189 items of equipment for both World Bank-funded and OECF-funded equipment. Of these, a total of 1,024 items or 86 percent were delivered and installed in laboratories all over the country.

The project aimed to construct 100 high school laboratories and upgrade 30 laboratories in tertiary institutions. The project has built 107 high school laboratories and upgraded 29 laboratories in tertiary institutions or 97 percent of target.

Actual disbursement by the World Bank is $51.9 million or 85.1 percent of the $61 million loan. Actual disbursement by OECF is Yen, 2,359.58 million or 77.2 percent of the Yen 3,055 million loan.

THE ESEP EXPERIENCE: INSIGHTS AND LESSONS FROM THE SOCIAL SCIENCE PERSPECTIVE

Beyond the figures, however, ESEP encountered challenges and difficulties in getting off the ground and during its implementation. Many of them stemmed from the social, cultural, political, and institutional matrix in the country. This is not to say that ESEP was not successful. The figures cited earlier point to ESEP'S successes with respect to manpower development and building science and technology infrastructure. Rather, by focusing on the challenges and difficulties encountered by ESEP, this paper brings out important insights and lessons from the ESEP experience, viewed from the social science perspective, that bear on the design and delivery of S&T policies and programs in the country. These are:

Major initiatives are often born out of strongly felt needs. The ESEP came out of the experience of the UP-Ateneo-La Salle consortium in mathematics and the sciences. The context of the consortium was that in the 1960s many people were sent abroad for PhD in math and science but few returned. Thus in the early 70s the schools were faced with departments which were in poor state in terms of faculties with PhDs. In order to address the problem, a group of scientists, among them, Dr. Ester A. Garcia, Fr. Bienvenido F. Nebres, Dr. William G. Padolina, Dr. Roger Posadas, and Dr. Paulino Tan decided to start local PhD programs with scholarship support for the students from the DOST. By 1985, the consortium was having some success but was also running up against a barrier especially for those who were doing experimental work. They could not do the experimental work in the country because of the lack of equipment. This was especially apparent in chemistry. The students had to wait until they had a chance to go abroad to run their samples. Moreover, the lack of equipment made it difficult to have larger numbers of students in the programs. Out of this difficulty, Dr. Ester A. Garcia and Fr. Bienvenido F. Nebres conceived of ESEP.

For large-scale S&T projects to be successful, champions are needed who, despite the many problems and hurdles along the way, will doggedly pursue the project with patience and determination to its successful completion. Dr. Garcia, Fr. Nebres, then DOST Secretary Ceferino Follosco, Secretary William Padolina, Assistant Secretary Lydia Tansinsin, and Undersecretary Estrella Alabastro are among the champions who zealously pursued the vision of the project despite the many barriers and difficulties encountered in getting if off the ground and on through its implementation. Secretary Follosco enbled ESEP to become a reality. Assistant Secretary Lydia Tansinsin was Project Director in the early years. After the project was institutionalized in the DOST, Fr. Nebres and Dr. Garcia together with Dr. Paulino Tan, Dr. David Booth, and Dr. Jose B. Cruz, Jr. were actively involved in guiding the project over the years through their Chairmanship and membership, respectively, in ESEP's Project Advisory Group. Secretary Padolina and Undersecretary Alabastro, ESEP Project Director, worked very hard to ensure the success of ESEP.

Champions need sponsors. As the project moves from the level of the individual to the level of organizations, top-level support is essential in order to have the resources and network of influence to push the project and get it started. The first major hurdle was getting the project funded. The proponents had to go for a foreign-funded program because it was very difficult, if not impossible, to get a budget for a large scale program for acquiring scientific equipment from the national budget (i.e., the General Appropriations Act). Congress would accept scientific equipment funded from a foreign loan but not from the national treasury. Initially, the proponents thought of the project as a 20 million dollar project for equipment acquisition, and at that time, they were thinking of looking for the funding themselves. Then Dr. Ceferino Follosco became DOST Secretary. He was very supportive and introduced the project and the project proponents to the World Bank, which subsequently agreed to fund the project. Secretary Follosco's push for the project was very critical: he marshalled support in the executive and legislative branches of the government to get the project off the ground. He even went to the extent of personally attending the technical group meetings at NEDA, which is something that a Cabinet Secretary does not normally do, in order to secure NEDA's approval of the project. In Congress, the strong support of Senator Edgardo J. Angara, the Chairman of the Education Commission, who understood and really cared for the project, was key to its approval. The succeeding DOST Secretaries, Dr. Ricardo T. Gloria and Dr. William G. Padolina were likewise equally supportive of the project, providing manpower, institutional, and financial support from the DOST.

Large-scale S&T projects have to be seen within a systems context. The system consists of all the aspects that are essential to achieving the objectives of the project. For the project to be successful, all of these aspects must be taken into account in the project design and implementation. Initially, Fr. Nebres and Dr. Garcia were thinking only of building up science departments through equipment acquisition. They soon realized that funding equipment was not enough; scholarship had to be part of the package. Then Secretary Follosco pointed out that in the modernization of the country, science by itself is not going to do it; engineering had to be included. Two other important components were also eventually included, namely, upgrading of libraries with science and engineering books, journals, and library materials and upgrading the research laboratories of the feeder high schools in science and technology. Thus, while the project started with the desire to build up science departments through equipment acquisition, in the end, the project's total package incorporated the various system components, together with the commitment of the various institutions involved, that were essential towards achieving the overall objective which is to support technology development for industrialization in the Philippines by increasing the supply of well-trained scientific and technical manpower.

The ESEP experience shows the political and bureaucratic context of getting a large S&T project going. This involves dealing with many government institutions with varying appreciations and perspectives of the role of S&T in developments. In order to get ESEP approved, the project proponents had to deal with a broad range of government institutions, primarily, NEDA, the Investment Coordinating Council, the DBM, and the Philippine Congress. This meant entering the political and bureaucratic arena. Three important policy debates had to be won. The first was the issue of whether or not government should borrow for higher education. At that time, some of the offices in NEDA were opposed to borrowing for higher education. Among the reasons given was that they had made calculations which show that there is a social return on elementary and high school education but only individual returns for higher education. Their position was that the individual, therefore, and not society, should invest in higher education. The project proponents argued that if every country believed that, then no country would support its universities. This was very difficult to get across.

The second policy debate had to do with the "flagship institution approach" versus the equity approach. The DECS philosophy, for instance, is based on equity: distribution of the resources across all schools in tandem with a special emphasis on the poorest or weakest schools. Thus, the policy makers in Congress raised questions like "Why do you support these schools who are presumably way up there in terms of their state of development? Why don't you go to the small schools out there in the mountains that do not have anything?" the project proponents had to convince the policy makers in Congress on the concept of developing "centers of excellence". In contrast to basic education, for the country to develop and compete in science and technology given very limited resources that we have, the better strategy is to focus those resources on institutions that have the potential to meet world standards in S&T education. The rationale is that if you give the limited resources to the schools who have the potential to reach world class standards, they will be able to pull up the other schools through a program of scholarships in graduate education for the faculty of the less developed schools. It was not easy to convince the policy makers that this was the right approach.

The third policy debate concerned the inclusion of private schools in the project. In terms of science and technology, private schools do not make money, in fact, they subsidize these programs very heavily. The project proponents argued that the private schools are performing a social service and therefore should be supported for it. The project proponents also pointed out that if ESEP were to be limited to the public institutions, it will not work. For instance, the number of graduates from state institutions in engineering is only 10 percent of the total so it won't make a very big dent. UP graduates very good but, relatively speaking, very few students. Moreover, the great majority of UP engineers are in management positions. By and large, the engineers actually doing the engineering work in most firms are typically from Mapua, UST, St. Louis, San Carlos, and other private schools. If the programs in these schools are not upgraded, then there will be no significant upgrade of the state of technology in the country.

After a lot of convincing and some political maneuvering, the project obtained the approval of NEDA and subsequently of Congress. The political maneuvering involved the cultivation of allies in the NEDA Board, especially the Department of Trade and Industry, DECS, and the Department of Finance, and getting the support of key people in Congress. The project was a breakthrough in so far as government financial support for higher education in science and technology and the flagship institution approach were concerned. It was also path breaking because the government accepted that it would treat the support for the private schools involved in the project on an equal basis as the public schools, that is, as a grant rather than as a loan.

On a yearly basis, the ESEP disbursements still had to be supported in the General Appropriations Act (GAA) via the DOST budget, even if these were funded by foreign loans. The project was approved in February 1992 and was supposed to begin immediately that year. However, since the GAA was approved in August 1991, there was no forward cover in the DOST budget for the project. Secretary Follosco used part of the existing DOST budget in 1992 to initiate some activities of ESEP in its first year. In the second year, ESEP was already included in the GAA but the amount allocated was still very small because of DBM rules which state that government agencies can only increase their budget by 10 percent. Thus, during the first two years, the project could not get off the ground substantially as only small parts of the project could be implemented. The DOST and the project proponents had to deal with Congress and especially with the DBM to finally get the levels of funding that were needed to fully implement the project.

On the political level, the issue that surfaced is that it is not clear to people, even among our top government decision makers, that science and engineering have a particularly important role in the development of the country. Our top government decision makers tend to see the development dynamics in terms of regulation law or in terms of finance and marketing. There is a yet little priority given to the S&T part of development.

The human-institutional-and-cultural subsystem is a very important aspect of large-scale S&T projects. The success of these projects requires getting the different individuals and institutions involved in the project aligned with the project's vision, goals, and implementation procedures. During the implementation phase, the project implementors had to deal with a large network of 29 tertiary institutions and 110 public high schools. These institutions had their own perspectives on science and technology, administrative personalities to deal with, and unique cultures and institutional structures which were not necessarily aligned with the vision, goals and implementation procedures of ESEP. There was the task of getting institutions and the school administration to understand what needed to be done and what their part was in making the project successful. This was not always easy. For example, it was difficult to get across how urgent it is that there should be stable power and water supply. At the very least, a deficiency in electricity and water means that there would be long periods when the equipment cannot be used, resulting in delays in the running of experiments and in the completion of graduate degrees. At the worst, the sophisticated equipment would be seriously damaged.

In promoting science and technology in the various institutions involved in the project, the implementors had to deal with presidents, chancellors, deans, department chairs, and high school principals who, many times, had their own perspectives on these matters. And they had to deal with very difficult personalities also, sometimes.

Dr. Alabastro had to spend a lot of time with the various individuals and institutions involved in the project in order to get them aligned with ESEP's vision, goals, and implementation procedures. In doing so, she had to understand and appreciate the objectives of the various players and then bridge the gap between these and those of ESEP. Also, least once a semester, she would sit down with the deans, and if necessary, with the chancellors or presidents if there was a problem that could not be solved by the dean. She would also meet with the students to find out what their problems and concerns were. Then she would meet with the advisers to validate what the students were saying. If there was an issue that needed the dean's intervention, she would go to the dean. If the dean was unable to solve the problem or the problem needed higher level intervention, Dr. Alabastro sought such. In short, the project required a lot of personalized follow-up and detailed work at the individual and institutional level.

The case of engineering was tougher than that of the sciences. There were more institutions in engineering of much varied levels. With the exception of the two engineering flagship institutions, the engineering colleges focused almost solely on undergraduate engineering education. There was virtually no research and advanced postgraduate training culture, and there were no significance research projects undertaken. The key school administrators in the various engineering colleges were largely not familiar with the direction and thrust spelled out in the science and technology Master Plan prepared by DOST.

To get the engineering administrators on board and aligned with the project, the ESEP held a series of workshops for the Deans of the engineering schools to assist them in their goal-setting, management, and implementation of the general upgrading of engineering education in relation to ESEP. An important component of the workshops was bringing the Deans to visit engineering institutions abroad. As the younger engineering faculty members sent abroad by ESEP were coming home with new ideas, the ESEP Project Advisory Group felt that if the Deans did not see for themselves how engineering education was happening abroad, i.e., greater use of laboratories and research in academe, the chances of faster implementation of whatever innovation the younger faculty members sent abroad by ESEP would like to introduce would not be very good. The program for the engineering Deans was very successful as the Deans became more supportive of innovations in engineering education, including the establishment of consortia for graduate education in engineering, the establishment of the Master in Engineering Program which was a more practice-oriented graduate program, a greater appreciation of the importance of having common research programs that their colleges could participate in, and the development of the Peer Evaluation Process which goes beyond conventional accreditation.

The ESEP brings out the formidable challenges to developing a science and technology culture in the country. This is because existing values; capabilities; and situational factors in the socio-cultural environment are not very compatible with a science and technology culture. The challenges run the gamut from, for example, equipment specification and the use and maintenance laboratories and equipment to the establishment of a research culture and the incentive structure to students and faculty.

In developing the laboratories, the World Bank required that equipment must be acquired through international bidding, which means that the equipment must be described as precisely as possible without naming a brand. It turned out that most of the science and engineering people in the participating institutions did not know how to do so. Although they had worked with the instrument, to describe it precisely was very tough work. One foreign member of the ESEP Project Advisory Group, Dr. David Booth, had to patiently help the participating institutions in this regard during the early years of the project.

Problems and concerns occurred with respect to sufficiency of equipment maintenance and repair especially in the flagship institutions where substantial equipment was inoperable due to lack of maintenance money. Similarly, in some of the beneficiary high schools, special laboratories were just gathering dust. Schools were not using them because they did not know how to use them. The problem with the manpower training component for the feeder high schools was that bringing the high school teachers to a place and showing them how to use the equipment was not enough. It was important to go to their place and actually work with them for a while to get them to understand how to work with the machines, something that was not programmed for initially in the project.

The ESEP Project Advisory Group observed the widespread absence of the culture and institutional mechanisms necessary for successful operation of research-based higher degrees among the participating institutions. Many university operating procedures in areas such as teaching loads and remuneration were disincentives to the development of this culture. For instance, in many of the institutions there is no credit load given for advising student thesis. The compensation given was in the form of a small honorarium per student graduated or for each semester that the student is enrolled for thesis direction. At the individual level, the difficulties arose in getting professors to understand what it is to guide a thesis, getting principals to understand what it takes to develop the teachers, and getting the teachers to understand how to work with the machines.

One of the areas in which ESEP has not made much progress is getting the graduate programs in the universities to perform better, specifically with respect to the culture of mentoring theses. Despite the fact that ESEP provided the programs for master's degree full support (tuition, salary, stipend, equipment, books, thesis expenses, etc.), the students took far longer to finish than had originally been planned. A big part of the problem had to do with the point of view that the thesis is solely the student's project. The idea that there should be a research group among the professors and the students become part of it and given subtopics has not really developed. Because this kind of environment which pushes and facilitates a student to move forward in his or her research work is not present, students took way too long to complete their thesis as they were, in many cases, running in circles.

The lack of a research culture and mentoring practice is aggravated by the poor incentive system in science and technology for both students and faculty. Reflective of the low desirability of S&T as a remunerative profession is the case of the first batch of graduates of the special science and math honors programs of the Iloilo High School of which 60 percent went into Nursing instead of science and engineering courses. Although seemingly extreme, the case of the Iloilo High School science and math honors program is not atypical as one need only look at the graduates of the Philippine Science High School and DOST scholars, the vast majority of whom end up in medicine, law, business, or other professions. In the case of faculty, especially those in engineering, the government-set research honoraria of PhP3,000 per month simply cannot compete with the lure of consultancy jobs.

ESEP brought out the differences between the management cultures of government institutions and educational institutions. ESEP was the first large-scale project where the DOST had to deal with universities and colleges and schools. The DOST system is by and large set up to give out grants on a piecemeal basis. It did not have the capability, especially during the early stages of the project, to interface and work closely with a broad range of secondary and tertiary level institutions.

The culture of the DOST is very different from the culture of a university. The DOST tends to sends a letter and expects an answer immediately Most professors wouldn't answer in a month. The DOST would sign letters which said "be guided accordingly." They did not appreciate that in the academe, you persuade and explain instead of order. There was much to be learned particularly with respect to how to deal with the culture of educational institutions.

As a result, the ESEP Project Advisory Group which technically was supposed to be only advisory ended up as a body that not only gave advice but also mediated and brokered between the DOST and the educational institutions, especially during the first half of the project. Many times also, the implementation problems that ESEP faced were simply beyond the experience of the DOST. Thus, the ESEP Project Advisory Group ended up at certain points managing some aspects of the project especially those that dealt with the universities here and abroad.

On the management level, what emerged was the importance of assessing at the outset what should be the capabilities of the DOST management team for managing complex projects like the ESEP and capability building in this regard, including the capability of dealing across institutions and cultures. During the second half of the project, Dr. Alabastro was able to solve a lot of the management problems of ESEP partly because she comes from the UP and understands the culture of educational institutions.

As ESEP draws to a close, the institutionalization at the DOST of the expertise and learning gained from ESEP's management is essential. The

ESEP was the first really big project of the DOST. It was a complicated project particularly because it involved a lot of institutions and individuals. At the start, there was not a very good appreciation of the complexity of the project. Indeed, initially, the DOST did not know how to manage it. Over time the ESEP Project Implementation and Coordinating Office (PICO) gained a lot of expertise in managing ESEP. For instance, they learned how to both macromanage and micromanage as the need arose. They learned how to manage the granting of large numbers of scholarships for graduate study both here and abroad. They learned how to deal with large-scale equipment and library materials procurement, civil works, and manpower training. And, not the least of which, they learned how to work with and get the cooperation of a wide variety of S&T educational institutions at the secondary, tertiary, and graduate levels. The issue now is how to institutionalize the expertise and learning gained from ESEP's management so that it is not just retained at the individual level but becomes an institutional resource of the DOST. Otherwise, when the next big project comes, the learning curve begins all over again. There is the concern that what was learned so painfully in the management of the project will be gone with particular individuals. For example, the person in charge of procurement did such a great job that he is now with the World Bank. Undersecretary Alabastro and many of the key people at the DOST are on secondment from the UP While this is a strength because it brings in expertise and linkages, its weakness is the continuity. The DOST has to retain some key people. Cleaning up the guidelines and procedures and putting systems in place are also critical. And of course, writing the story of ESEP and its management will help keep the lessons alive.

S&T POLICIES AND PROGRAMS AND THE SOCIAL SCIENCES

The challenges and difficulties that ESEP faced shows that the problem of developing science and technology in the country is embedded in a whole matrix which is social, cultural, political, and institutional. In view of this, social scientists have much to contribute to the design and delivery of S&T programs in support of policy. First, social scientists can assist in the diagnosis of the various systems and subsystems, especially the human- institutional-and-cultural subsystems, that will be involved in the S&T effort. The diagnosis can especially focus on the incompatibilities and resistances that have to be overcome within the system and on the management capabilities, systems, and structures that will be needed in order for the change effort to succeed. Second, social scientists, especially those in the organization development field, have developed methodologies on how to assist individuals and organizations align themselves to the vision and objectives of planned change efforts. A discussion of the specific strategies for doing this is beyond the scope of this paper. Suffice it to say that these strategies have been used successfully in many planned change efforts across a wide variety of fields. Third, social scientists can also be brought in during project implementation to conduct formative evaluation of the project as it is being inplemented so as to identify the processes that need to be retooled or redesigned particularly with respect to the human system during the implementation process. Finally, for change efforts in science and technology development to be sustainable long after the project is over, there has to be a culture change. Social scientists can assist in determining what needs to be done to help achieve the culture change and in evaluating whether such is indeed being achieved during the change effort.

We would like to conclude this paper with the following metaphor: If one goes to Europe now, one marvels at the cathedrals and the work of Michelangelo and the other artists. There is of course the artistic greatness of Michelangelo and the others. But there is also the fact that patrons supported and paid not just for Michelangelo but for the other artists as well. There was a whole group of painters and sculptors who were supported by society. This is precisely the question that faces us in developing science and technology in our country today. When we look at the development of science and technology in the West as well as in the successful East Asian countries, there was and continues to be a matrix of support. This is something that is around in our country only in little bits and pieces. Thus, science and technology is not seen as something that is desirable to go into among our students. And even among our S&T people, the academics often got discouraged by the incentive system while the better engineers in industry aspire for management positions. We lament it but we don't do something about it. These are, technically, not science problems. They have to do with culture, politics, management, the building of institutions, and other aspects of the broader social and cultural arena. And this is something that concerns and should be addressed not only by the S&T community but by the social science community as well.

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SCIENCE AND TECHNOLOGY POLICY AND SOCIAL SCIENCES

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INTRODUCTION

Let me begin by complimenting the organizers of this year's annual scientific meeting of the Academy for the elaborate preparations as well as for the quality and breadth of participation in the plenary sessions, in the simultaneous scientific paper presentations as well as in the poster presentations and exhibits.

Worthy of very special commendation were the three Pre-Congresses organized in preparation for this regular congress. I had the privilege of attending some of the sessions and I was very pleased and very much encouraged to note the coming together of the disciplines (and their practitioners) in discussing many important issues of national concern whose effective resolution would be possible only with multidisciplinary complementation.

If the only outcome of this year's congress is the realization by our scientists of the desirable outcomes of meeting more often with colleagues from other disciplines – to educate one another, to explore and share new horizons and perspectives, to share techniques, methodologies in dealing with the challenges before us – the Academy and the PSSC would have achieved a great deal.

This morning Academician Bienvenido F. Nebres and I have been asked to initiate the discussion on science and technology policy and social sciences.

The first observation I will make is that Science and Technology (S&T) would profit immensely from the reflections and inputs of the social sciences. Because, after all, whether we recognize it or not, the formulation of policies that enhance or constrain scientific and technological activities in the country is *essentially a social process,* informed by political and economic imperatives. Unfortunately, very few social scientists have systematically examined this process to draw insights that can guide the scientific community in its advocacy efforts.

To date, the only serious work on the subject is still Olivia C. Caoili's thesis on the changing structures, processes, and directions of policy making for science and technology in the Philippines. Since the time it was written almost twenty years ago, no other social scientist has been sufficiently challenged to identify and address issues in S&T policy even at this juncture in our history when the nation's future hinges on the development of its people and technological capability.

My brief presentation this morning shares personal observations regarding the process of policy formulation for S&T. I hope these observations can serve as inputs to the theoretical reflections of social scientists on policy making in this area and challenge them to be more involved in shaping the direction of our country's S&T Policy.

PUBLIC POLICY FOR SCIENCE AND TECHNOLOGICAL ACTIVITIES

Public policy for science and technology is conventionally defined as what government does for three categories of scientific and technological activities, namely:

- experimental research and development,
- scientific and technological support services, and
- scientific and technological education and training.

The first category includes, among others, the creation and support for research institutes, provision of laboratories and experimental fields as well as incentives for researchers.

Under the second category are provisions for scientific libraries and information/communications systems; museums, geological surveys, meteorological and seismological observations, setting up of industrial and scientific tests and standards, issuance of patents; and other technical and laboratory support.

The third category covers support for scientific education and training at the tertiary level. In our system as well as in other countries basic science education and training is the purview of the Department of Education (or Ministry).

Thus, in assessing the state of scientific and technological development in a country, the indicators or parameters resolve around these three sets of activities: For example, in comparing ourselves with our Asian neighbors, we look into

- Where are our research laboratories?
  How well-equipped are they?

- What is the ratio of scientists and engineers, to the total population; what is the percentage of PhD holders among scientists and engineers?

- How many scientific papers are published in the science citation index?
- How many patents are issued?

And if the country is found wanting in these measures, as in our case, the explanation is sought in the lack of or inadequacy of the state's S&T policy.

But how are S&T policies made" Who makes them? How are they implemented?

Public policy on S&T are made at different levels by different actors. At the highest level is the constitution where invariably the statement is "that the state gives the higher priority to science and technology" or some noble elaboration to such effect.

At the next level is Congress which enacts or passes legislation to give flesh and meaning to the priority for S&T and allocates a budget or resources for their implementation.

At the next level is the executive branch, from the President himself, down to the members of his cabinet, more specifically, the secretary for Science and Technology, who spells out the administration's policies, priorities, programs, and resource allocation for S&T activities during its incumbency.

Thus in many forums, solutions are sought from or issues addressed to these sources of formal S&T policy.

While this is true, it is not as if we in the scientific community are completely helpless or voiceless in crafting or directing S&T policy. On the contrary, many effective policy choices for science and technology in the Philippines are in fact left largely to administrators, and scientists in research institutions and universities. This constitutes my second observation.

Consider the fact that a very significant part of experimental research and development and scientific higher education is conducted by UP and the bigger SUCs.

Given the academic autonomy of UP and the SUCs and the jealousy with which the faculty guards its academic prerogatives, and responsibilities, it will not be entirely wrong to claim that in fact much of S&T policy in the past as in the present have been decided within the halls of academe.

This realization has led the previous secretary of the Department of Budget and Management (DBM) to propose that the Department of Science and Technology be under the administration of UP to save on cost.

I have been President, Chancellor, Director of a research institute and practising scientist in the university. I know for a fact that most of the effective choices for R&D for scientific higher education are conducted by the professors and research directors/deans. Not by the President nor by the Chancellor! Not by DOST. Not by Congress.

An effective research director/dean will, from to time to time enlist the support of the President and Chancellor but the initiative, priorities, and strategies reside mainly with the faculty and academic leaders.

Contributions of social scientists to S&T Policy Formulation. At this point, it is appropriate to ask what have been the contributions of social scientists to the formal formulation of public policy on S&T activities. Here it is useful to make a distinction between the national science agency and other executive departments.

Unfortunately, there is little by way of record which reflects the unique contribution of social sciences in S&T formulation in the DOST.

More of the significant players in the national S&T scene in post-war years had been medical doctors, physicists, engineers, chemists, and agricultural scientists, with a few exceptions.

In the reorganization of the science community in 1982, for instance, the impetus for social innovations such as the organization of sectoral research councils; the regionalization of S&T activities; the recognition of science communities and later of S&T parks; the institution of the science career service; and the recognition of national centers for scientific excellence came largely from natural scientists and engineers.

In recent years, the elevation of the science agency to a formal department, the establishing of S&T parks, and the conceptualization of the ESEP project resulted from initiatives of natural scientists and engineers.

Nevertheless, it should be noted that PCARRD which served as the model for the sectoral council system recognized early on the central role of farmers -- the users and beneficiaries of information -- in the technology generation and utilization continues.

For this we must acknowledge the role of social scientists in UPLB and UP Diliman particularly Prof. Gelia T. Castillo and Prof. Manuel F. Bonifacio who very skilfully persuaded the agricultural technologists of the benefits of having social scientists as partners and collaborators in agricultural research.

SOCIAL SCIENTISTS AND TECHNOLOGY POLICY

But S&T policy is crafted not only by the national science agency (DOST). On the contrary, continuing strategic choices adopted by other cabinet departments (other than DOST) set the parameters of the nation's S&T activities, not the other way around.

The links between social scientists and S&T policy in the national science agency are tenuous at best but they do have a lot of voice in the technology choices adopted by the other line departments.

For example, the debate whether we should pursue a policy of food self-sufficiency or food security has raged for some time. However, the economists have carried the day; now the official policy as far as agriculture is concerned is *food security.*

I do not have time to elaborate on the profound differences between these policy options. Suffice to say that this policy option has far-reaching consequences for research priorities in agriculture. This public policy decision which was made outside of DOST will determine the direction, timing, and scale of efforts along the three clusters of S&T activities described.

A second significant example is the national policy on social forestry. After so many decades of forestry education and research on silviculture, logging, and forestry products engineering, the social scientists in Los Baños and their allies in the DENR, NGOs, and farmer groups succeeded in turning priorities around the needs of communities and the compatibility of forest management practices with their needs. So marked was the paradigm shift that the recent reorganization of the UPLB College of Forestry almost went overboard in renaming their college, the *College of Social Forestry.*

But one of the better-documented collaboration among social scientists, natural scientists and engineers in S&T-related policy occurred at the level of the National Irrigation Authority. Social science research from Ateneo de Manila's Institute of Philippine Culture, the International Rice Research Institute, the Asian Institute of Management, the Central Luzon State University, and UPLB succeeded in helping transform the official top-down paradign held by the National Irrigation Authority (NIA). In NIA's traditional approach, engineers designed, built, transferred, and rehabilitated irrigation systems without consulting end users. As an alternative, the researchers fleshed out a participatory framework, detailing procedures, processes, and policies which the farmers eventually found useful and adopted.

The links between the social sciences and S&T-related policies have not always been as fruitful. It may be useful to state some of the more obvious failures of public policy due to lack of social science input in their formulation but I will leave that up to you. We do have success stories where social scientists have made important contributions to S&T-related policies.

TECHNOLOGY POLICY REQUIRING SOCIAL SCIENCE SUPPORT

It is always good to have a sense of the past – a notion of how well we have done in some situations, and how poorly we have done in others. I look at history with a utilitarian purpose as a guide, a reminder, a call to arms to do better in the future.

In the next few minutes, I would like to dwell on prospective social science contributions to S&T policy.

With or without the intervention of social scientists S&T policy continues to be articulated, supported, and implemented at all levels of government.

The myriad and very complex problems and solutions that face the nation have technology implications:

- graft and corruption, lack of transparency, role of access to information and communication, information technology;
- problems of waste disposal and the appropriate mix of solutions – landfills, incinerators, and recycling;
- lack of energy resources and will to harness various energy sources – tidal waves, ocean thermal gradients, geothermal energy, fossil fuels, nuclear power, solar panels – and the need to make them socially acceptable;
- monstrous traffic jams, inadequate mass rail or highway transport, lack of discipline to hurdle such problems, and poor urban planning; lack of land use and zoning;
- the need for electoral reform and computerization;
  problems of population, nutrition, health, food science, genetic engineering, and transgenic plants;

The list can go on and on.

But invariably, these technology fixes will affect how people behave, think, and organize their lives. They have to be made aware of modern technologies that will address our collective problems. It is the task of the social scientists to process new technologies with future users who will either weave the notions and ideas behind the technology into their own cultures or press for the modification of the technology to suit their idiosyncracies and those of bigger social institutions.

For example, so many of the seemingly intractable problems of Philippine agriculture can be traced to the failure to recognize its essential duality -- as an industry and a way of life. I have had a running argument with some of my economist friends who keep harping on the weaknesses and limitations of the Philippine agriculture R&D system. I think they have got it all wrong. Philippine technical capability in agriculture is better than most developing countries. In fact, our indigenous technologies are being adopted elsewhere. Our scientists sit as advisers in international bodies and serve as consultants in many countries.

To my mind, the weak point in Philippine agriculture is not technology generation *per se* but its articulation with a broader economic, political, and social environment and with the farmers and end-users.

Against this backdrop, we may generalize that policies are likely to succeed when the natural and social sciences complement each other. The greatest strength of the natural sciences lies in their rigor and value-neutrality. But this strength turns into weakness when scientific recommendations fail to take into account the political context or social milieu of a particular course of action.

This is where we need each other. Many social scientists have borrowed the methods of the natural sciences to enhance the rigor of their disciplines. Lately, the natural sciences have returned the favor by paying more attention to the social and ethical consequences of scientific discovery and technological development. This trend is exemplified by the growth of science and technology studies or STS that focus on the impact of S&T on society.

Thomas Kuhn, who originated the concept of a 'paradigm shift' is credited as the father of STS demystified the process of scientific discovery by explaining that

> The process of science is fundamentally human, that discoveries are the products not of some plodding rational process but of human ingenuity intermingled with politics and personality – that science is, in the end, a social process (Gladwell in Javaid, 1997).

This convergence between the natural and social sciences augurs well for the successful pursuit of S&T policy.

So as our country moves on to its second century, what are the challenges and opportunities in which social scientists can play a more crucial role?

How should the social sciences and social scientists organize and position themselves to make a difference?

If more social scientists would only stop to reflect on the answers to these questions, then I think the Pre-Congresses and this Annual Scientific Meeting would have achieved their purpose.

In summary, practically all the complex and difficult problems facing Philippine society today have science and technology underpinnings and implications. Fortunately, there is a growing convergence around the realization that the successful resolution of these challenges requires complementary, multidisciplinary approaches.

Such being the case, the articulation of public policy for scientific and technological activities ought to be the concern not only of the natural scientists and engineers alone but also of social scientists and humanists. The purposive crafting of S & T policies and their effective implementation is a worthy subject for social science research. Unfortunately it has not received much attention.

In the systematic study of S & T policy formulation and in enlisting the active role and participation of social scientists in the exercise, reiterating the following observations of the Philippine experience may be useful:

1. S & T policy formulation occurs at different levels. The constitution, congress, and the executive departments each have their roles. However, it is not as if the scientists and the research and higher education institutions are merely passive receivers of S&T policy.

As a matter of fact many effective policy choices in S&T activities are decided by scientists and research administrators themselves.

UP and the SUCs are major S&T players. Beyond the aggregate budget levels, the universities (meaning the faculty) pretty much decide what their priorities are.

2. Historically, social scientists have had relatively little role in S&T policy making in the national science agency (presently the DOST). However S&T policymaking is also being done in the other executive departments. The technology choices adopted by executive departments in many cases effectively determine the priorities directions, timing, and scale of S&T activities in DOST, in the SUCs, as well as in the private sector.

3. Technological choices are continuously being made at the national level. The national scientists and engineers need to carry out their assigned tasks of assessing, innovating, adopting these technologies to suit local physical and biological conditions. The social scientists ought to work hand-in-hand with their counterparts in assessing the social, economic, political, and cultural compatibility, acceptance and adaptability of these technologies.

4. Fortunately, there are increasing examples of technology-based strategic choices by executive departments when social scientists have made significant contributions. Let us build on this track record and get more involved. If we do, the problem of inadequate resources for the social sciences will resolve itself.