BASIC DESIGN STUDY REPORT
ON
CONSTRUCTION PROJECT
OF
PHILIPPINE INSTITUTE OF PURE AND APPLIED CHEMISTRY
IN
THE REPUBLIC OF THE PHILIPPINES

October 1982

JAPAN INTERNATIONAL COOPERATION AGENCY

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PREFACE

In response to the request of the Government of the Republic of the Philippines, the Government of Japan decided to conduct a Basic Design Study on Construction Project of Philippine Institute of Pure and Applied Chemistry and entrusted the survey to the Japan International Cooperation Agency (J.I.C.A.). The J.I.C.A. sent to the Philippines a survey team headed by Mr. Hideki Abe, Head, Basic Design Division, Grant Aid Department, J.I.C.A., from June 28 to July 17, 1982.

The team had discussions with the officials concerned of the Government of the Philippines and conducted a field survey in Quezon City, Metro Manila. After the team returned to Japan, further studies were made and the present report has been prepared.

I hope that this report will serve for the development of the Project and contribute to the promotion of friendly relations between our two countries.

I wish to express my deep appreciation to the officials concerned of the Government of the Republic of the Philippines for their close cooperation extended to the team.

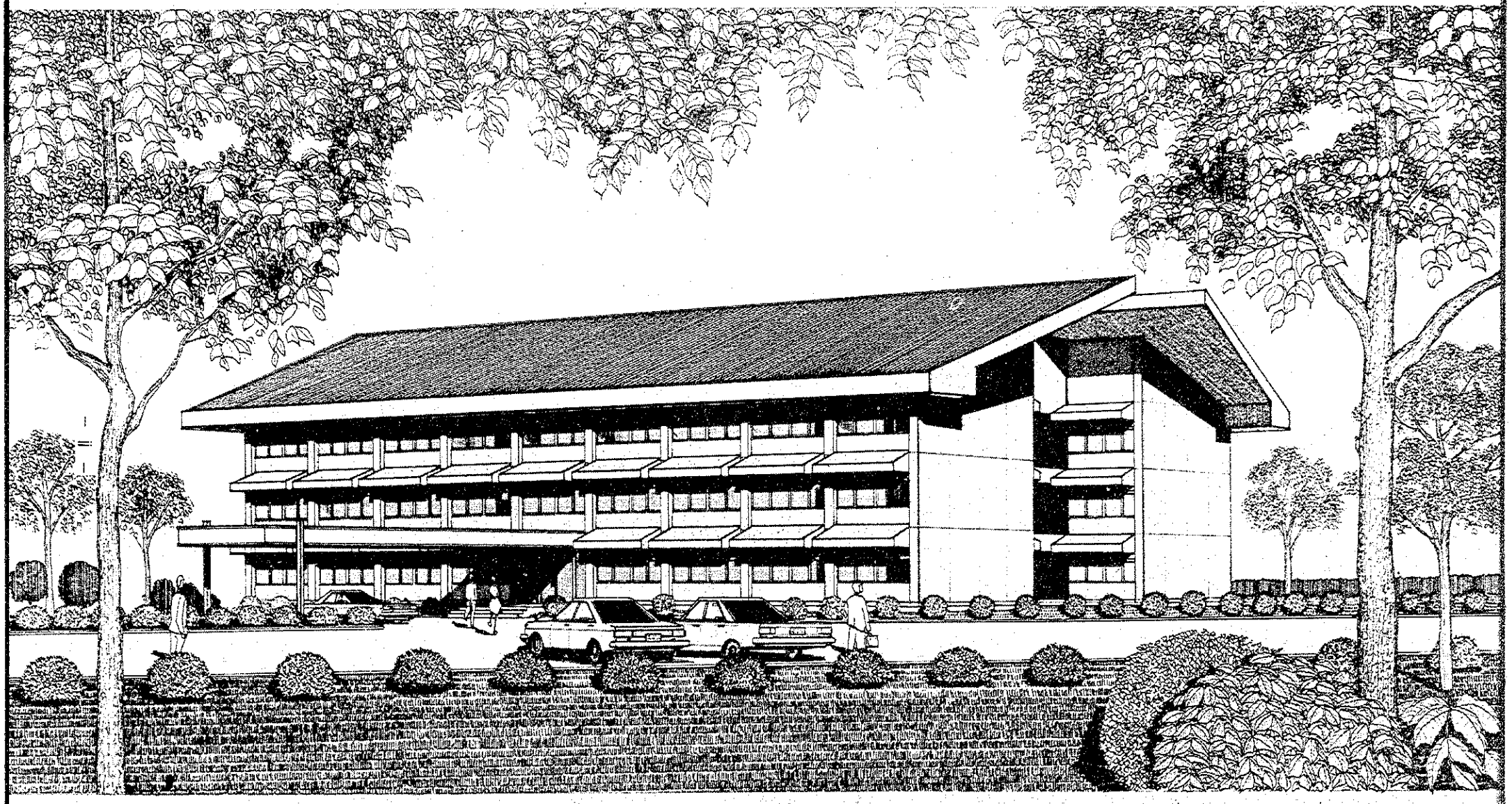
October, 1982

Keisuke Arita

Keisuke Arita

President

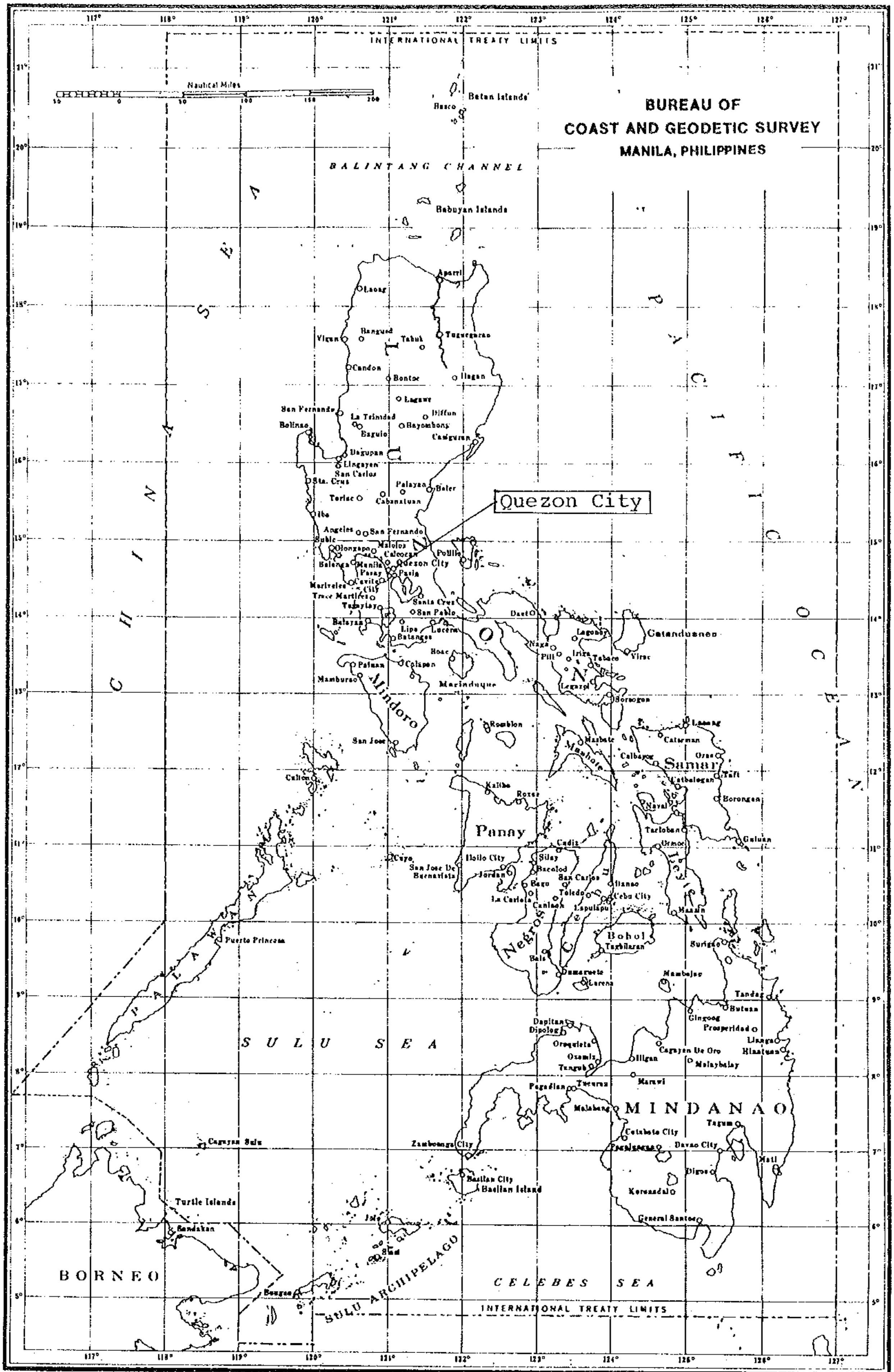
Japan International Cooperation Agency



PERSPECTIVE VIEW OF NEW PIPAC BUILDING

No. 3083

Mercator Projection Scale 1:5,000,000 at lat. 13°



Philippines Base Map 1968

Published at Manila, Philippines, Dec. 1968
PHILIPPINE COAST AND GEODETIC SURVEY
Cayetano Palma, Director

P.C.&G.S. 3083
PRICE P0.50

MAP OF THE PHILIPPINES

SUMMARY

From the onset of the Second Four Year Philippine Development Plan started in 1972 with "Constitutional Authoritarianism", a doctrine declared by the Philippine Government, to the current Five Year Philippine Development Plan (F.Y.P.D.P., 1978 to 1982), the Philippine agricultural sector has been projecting self-sufficiency in food and now is producing more food for export while the industrial sector has been increasing its share of the gross domestic products from 31 percent in 1972 and 34 percent in 1976 to 38 percent in 1981, gaining more importance in the drive for a self-sufficient economy. In addition to the development of major industries, like steel producing or vehicle manufacturing, development of local industry using local resources and labor is an urgent need in the Philippines. However, the capacity of both public and private institutions to provide technical consulting services for small and medium size industry remains small at present. As for the industrial chemistry, chemical laboratories attached to government offices and chemistry departments of universities answer demands for technical consultation and various industrial chemical analyses.

The Philippine Institute of Pure and Applied Chemistry (PIPAC) is a private, non-stock, non-profit corporation certified by the National Science Development Board of the Republic of the Philippines. It was founded in 1975 separated from the Ateneo de Manila University Chemistry Department to provide essential chemical services needed by the public, in particular by the growing chemical and agricultural industries of the Philippines. The Institute offers services which include the following items.

1) fulfillment of the need for chemical analysis

2) fulfillment of the need for chemistry-related technical training

3) offer chemistry-related consulting and research and development services

4) offer maintenance services in future for analytical equipment and to contribute to the spread of maintenance techniques.

Among these purposes, chemical analyses comprise 72 percent of total income in 1981. The range of services related to various industries, especially demands by small companies in the food industry including fish, agricultural products and biochemistry take up a large percentage. Demands for pollution-related analysis are also high, which reflect the present situation of Philippine industry.

As for chemistry-related technical training, PIPAC holds seminars inviting many participants and mainly provides theoretical and practical training on electronic analytical equipment. These training and seminars are enjoying a favorable reputation among various industries and have been held more frequently year by year.

Research and development services consist of long-period commissioned researches from major companies and requested researches for the solution of temporary troubles from small companies. Since there are few other institutions capable of responding these urgent demands from industry, the improvement of these services is the most requested. Future demand to these services is expected to be remarkably large.

Maintenance services for the analytical equipment are rather behind in the Philippines. Various kinds of high technological equipment are left unattended in many chemistry laboratories because of the insufficiency of guidance in handling methods and maintenance technique as well as a

shortage of spare parts. PIPAC is expected to contribute to rehabilitation of a hoard of equipment and to the improvement of Philippine chemical analysis capacity.

At present PIPAC provides services in rented offices and laboratories in the chemistry building of Ateneo de Manila University. Training and seminars and some of the research & development services are held on holidays or in the evenings in intervals in the schedule of the university courses, because the demand for services is far greater than the capacity of PIPAC's laboratories. On account of these limitations, long-term research commissions from major companies as well as one-third of the analytical services requests have to be turned down. In order to improve the present situation and to fulfill the needs of Philippine industry, the government of the Philippines through Ministry of Trade and Industry has requested the grant aid of Japan for a building and equipment of PIPAC.

The 10,000 m^2 area project site is located in the campus of Ateneo de Manila University on a hill called Loyola Heights, southeast of Quezon City. The basic policies in designing the project are as follows:

(1) to design the building suitable for Philippine's local weather and geographic conditions,

(2) to harmonize with the environment of the surrounding area,

(3) to respect local construction methods utilizing domestic Philippine products and materials as far as practicable, and

(4) to minimize the maintenance and running costs after completion of construction.

The project building is planned to be of 3 storeys aiming at a short construction period and low construction cost. The project building is designed to use the side corridor system with a courtyard. The air-conditioned area is to be the minimal space because of the initial and running costs, and a natural ventilation system is to be applied to most of the rooms. The total floor area is palnned to be about 3,000 m^2 based on the personnel procurement program and the capacity of the laboratory functions. Problems of infrastructure are few as the project site is in the well-equipped university campus. It is expected to take eighteen (18) months to complete the project including fourteen (14) months construction period.

The selection of types and amount of the analytical equipment has been decided based on the frequency of use and the efficiency in combination with the present PIPAC's equipment. A simple system with a minimal possibility of trouble is the principal concern. A neccesary amount of spare parts is to be also included in the grant, in view of the present condition.

PIPAC's incomes since 1977 show 28.6 percent annual growth, 273 percent over all, while expenses have increased by 41.6 percent, over four times in five (5) years. The increase of expenses attributes to the expansion of personnel costs. Difference of income and expense, that is the excess of income remains 1.9 percent increase rate, which is due mainly that PIPAC has hardly raised its service charges since the establishment. Fund balance shows proper growth. PIPAC owns deposits almost equal to the annual income which earns non-operating income and contributes to sound finance. From the financial point of view, PIPAC has grown properly in the past and keeps good capital condition. However, around

30 percent of price rise is considered necessary to compensate for the decrease of the ratio of net income to gross income and to accord with increase of new staff members.

After this price rise is realized, PIPAC is able to bear sufficient excess for depreciation of the analytical equipment in 10 years, along with the improvement of its organization growth based on the five-year program, but the builidng will not be depreciated. That is, this project cannot be realized in case that the commercial principal requiring interest payments and its repayment is alloted for its operation. In conclusion, this project cannot be realized but by Grant Aid. A large effect is confirmed by Grant Aid from the government of Japan.

The difference between the income aimed at if this project were managed by a profit-seeking institution, and the income kept considerably low because it is a non-profit institution is regarded as economic benefit that is to be received by the users for which PIPAC provides services and by the Philippine industry. This economic benefit is estimated to be 8.5 million pesos (equivalent to about 240 million yen) in 10 years from 1984, without including payments for dividends and interests or any profits which are naturally needed if it were a profit-seeking institution.

The following recommendation are presented regarding the realization of the project.

(1) PIPAC shall raise the present service charges by around 30 percent by the onset of operation in the new facilities in 1984

(2) PIPAC shall prepare one million pesos (about 28 million yen) as the initial funds for the running costs and the purchase of accessories

(3) A regular institute director shall be appointed to clarify the responsibility of the new organization and to provide efficient service

activities. All the directors of each department shall also be full-time staff members by the time of completion of the five-year program.

(4) Considering the fact that the personnel cost shares almost 65 percent of the total costs, procurement and disposition of personnel shall be carefully scheduled, while active advertising and promotion are suggested, especially the promotion of research and development services is the most important.

(5) The government of the Philippines is recommended to provide assistance necessary for the PIPAC's public service activities.

CONTENTS

CHAPTER 1 INTRODUCTION

CHAPTER 1 INTRODUCTION

A request was made by the government of the Philippines to the government of Japan for grant aid in the construction of a new building and chemistry analytical equipment for the Philippine Institute of Pure and Applied Chemistry (PIPAC) a research institute for analysis, guidance and advice on chemistry related problems in all industrial sectors, as a part of Philippine Industrial development.

In response to this request the government of Japan dispatched a basic design study team through Japan International Cooperation Agency (JICA) to the Philippines from June 28 to July 17, 1982. The objectives of the study team were to explain to Philippine officials concerned the policies, systems and procedures of grant aid of the Japanese Government, to confirm the responsibilities of both countries, the content of conceptual planning of the building and analytical equipment, and to collect referential data necessary for the project. The study team conducted a field survey to understand the trends in Philippine industries which forms the background of the project, the present situation of chemistry education and other similar chemical laboratories, construction conditions, related law and regulations and infrastructure.

As the result of the survey and discussions, basic items agreed on as the objectives and substances of the project, a tentative site plan, building plan and analytical equipment list and they were compiled in the minutes of discussions signed by the Japanese study team and the Philippine Authorities concerned namely Director Ignacio G. Salcedo, Jr., Product Standard Agency, Ministry of Trade and Industry, and Dr. Modesto T. Chua, executive director, Philippine Institute of Pure and Applied Chemistry, July 2, 1982.

The government of Japan dispatched the second mission for draft report through JICA from August 29 to September 4 to discuss and finalize the basic design study report. The mission achieved the final confirmation and exchanged the signing on the minutes of discussions with the Philippine Authorities concerned.

* Yokogawa Architects and Engineers, Inc. participated in the basic design study.

CHAPTER 2 BACKGROUND OF THE PROJECT

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2-1 Trends in Philippine Economy and Research Activities

2-1-1 Economy

As for the Philippine economic situation, the GNP (at constant prices indexed for 1972) increased from 55.5 billion pesos in 1972 to 73.3 billion pesos in 1976 and 92.9 billion pesos in 1980 on account of the government policies such as the promotion of exporting industries, price controls and the application of the floating foreign exchange rate. The net economic growth rate was 4.7 percent, against a target of 6 percent, while the inflation rate was said to be 17 percent in 1980.

The Philippines is an agricultural country producing rice, sugar, coconuts, etc. 47 percent of its population is concerned with agriculture. The target in rice production is for the country to become self-sufficient, and it is producing more rice for export. The export of agricultural products suffers the influence of the world market directly; the amount of sugar exports decreased by 68 percent in 1978 compared to the year before.

The government, promoting the development of secondary industry, presented an industrial development plan in 1979, centered on eleven (11) sectors for the acquisition of foreign currencies. This plan includes copper manufacturing, phosphate fertilizer, aluminum refinement, steel manufacturing, petrochemicals, diesel engines, cement, pulp and paper manufacturing, coconut production, etc. The government founded EPZA and started the construction of processing complexes for exports in Mariveles and Bataan districts. Table 2-1-11 shows the investments in each sector in F.Y.P.D.P. (1978--1982)

The results of the investments are indicated in table 2-1-12.

Table 2-1-11: INVESTMENT IN F.Y.P.D.P. (1978 ~ 1982)

Sectors	Domestic Currency (million ₱)	Foreign Currency (million US $)	Total (million ₱)
Agriculture & Marine Products	2,487.0	217.5	4,118.3
Local Development	3,069.0	400.0	6,069.0
Industry	6,977.5	1,850.0	20,852.5
Social Development	637.5	1,850.0	8,285.0
Transportation	12,441.0	1,552.6	24,085.5
Telecommunications	1,526.0	225.0	3,213.5
Electric Power	23,750.0	4,190.0	55,175.0
Water Resources	21,529.0	2,318.0	38,914.0
Total	72,417.0	11,762.1	160,632.8

from Five Year Plan, NEDA

Table 2-1-12: GROSS DOMESTIC PRODUCT RATIO
(at constant 1972 prices)

Industry	1972	1976	1980
1. Agriculture, Fishery and Forestry	28.61	26.73	25.70
2. Industrial Sector	31.10	33.85	36.28
a. Mining & quarrying	2.40	2.03	
b. Manufacturing	23.88	23.76	25.32
c. Construction	3.99	7.14	7.32
d. Electricity, gas & water	0.83	0.92	1.08
3. Service Sector	40.29	39.42	38.02
a. Transport, communication & warehousing	4.31	4.84	5.31
b. Commerce	22.63	21.66	20.56
c. Services	13.35	12.93	12.15
Total	100.00	100.00	100.00

The Five Year Philippine development programs from 1978 to 1982 are intended to attain the following major purposes

(1) Social development

(2) A self-sufficient economy

(3) A well-balanced, competitive economy

(4) Local development including agricultural districts

(5) Improvement of environmental and residential conditions

(6) Balanced and productive international relationships

(7) Peace and public order

For practical purposes, contributions from industry to social development and to well-balanced local development as well as the development of indigenous industry using local natural resources play a major role.

2-1-2 Research Activities

The National Science and Technology Authority (NSTA), formerly known as the National Science Development Board, has drawn up a five-year science and technology development plan for 1983 to 1987, succeeding F.Y.P.D.P., that aims to improve and adopt indigenous and foreign technology, improve science and technology resources (facilities as well as manpower), and increase the participation of the private sector in research and development activities for the purpose of technological development in industry and the other productive sectors, agriculture, fishery and forestry, and of the citizens' health. NSTA is adopting a "demand-pull" strategy toward technological development to respond to the actual perceived demands of industry and the citizenry.

Agriculture and forest research will be promoted under the supervision of the Philippine Council for Agriculture and Resources Research and Development. Industry will be given support in the form of tests and

Table 2-1-13: GROSS NATIONAL PRODUCT, NATIONAL INCOME AND GROSS DOMESTIC PRODUCT BY INDUSTRIAL ORIGIN: 1970 TO 1980

(In million pesos at constant 1972 prices)

Industry	1970	1971	1972	1973	1974	1975	1976	1977	1978[r]	1979[r]	1980[p]
1. AGRICULTURE, FISHERY AND FORESTRY	14,734	15,457	16,040	17,026	17,405	18,218	19,671	20,846	21,602	22,837	23,627
2. INDUSTRIAL SECTOR	15,048	16,222	17,442	19,586	20,710	22,000	24,004	27,564	29,498	31,607	33,554
a. Mining & quarrying	1,003	1,282	1,348	1,400	1,403	1,445	1,491	1,742	1,809	2,134	2,350
b. Manufacturing	11,823	12,611	13,388	15,252	15,981	16,537	17,481	19,632	20,966	22,155	23,283
c. Construction	1,738	1,889	2,240	2,433	2,745	4,101	5,254	6,568	6,963	6,368	6,232
d. Electricity, gas and water	394	440	468	501	581	007	678	712	771	850	989
3. SERVICE SECTOR	21,232	21,847	22,593	24,319	25,904	27,453	29,010	29,790	31,572	33,242	34,966
a. Transport, communication and storage	2,056	2,184	2,418	2,657	2,933	3,277	3,559	4,235	4,501	4,636	4,886
b. Commerce	12,295	12,484	12,688	13,589	14,351	15,056	15,938	16,838	16,861	17,960	18,908
c. Services	6,881	7,179	7,487	8,073	8,680	9,120	9,513	9,717	10,210	10,646	11,172
GROSS DOMESTIC PRODUCT at market prices	51,014	53,526	56,075	60,931	64,139	68,381	73,585	77,990	82,572	87,386	91,947
Net factor income from the rest of the world	(979)	(605)	(549)	(50)	600	100	(244)	(201)	1,136	1,369	964
GROSS NATIONAL PRODUCT	50,035	52,921	55,526	60,881	64,739	68,530	73,341	77,789	83,708	88,755	92,911
Indirect taxes net of subsidies	3,666	4,225	4,382	5,482	6,827	7,143	7,036	7,018	8,092	9,350	9,514
Capital consumption allowance	4,712	5,019	5,353	5,535	5,849	6,324	6,847	7,534	7,981	8,447	8,930
NET NATIONAL PRODUCT OR NATIONAL INCOME	41,657	43,677	45,791	49,864	52,263	55,063	59,458	63,237	67,635	70,958	74,467

[r]Preliminary estimates as of December 1980.

Source: National Accounts Staff, Statistical Coordination Office, National Economic and Development Authority.

Fig. 2-1-11

GROSS NATIONAL PRODUCT, NATIONAL INCOME AND GROSS DOMESTIC PRODUCT: 1970-1980

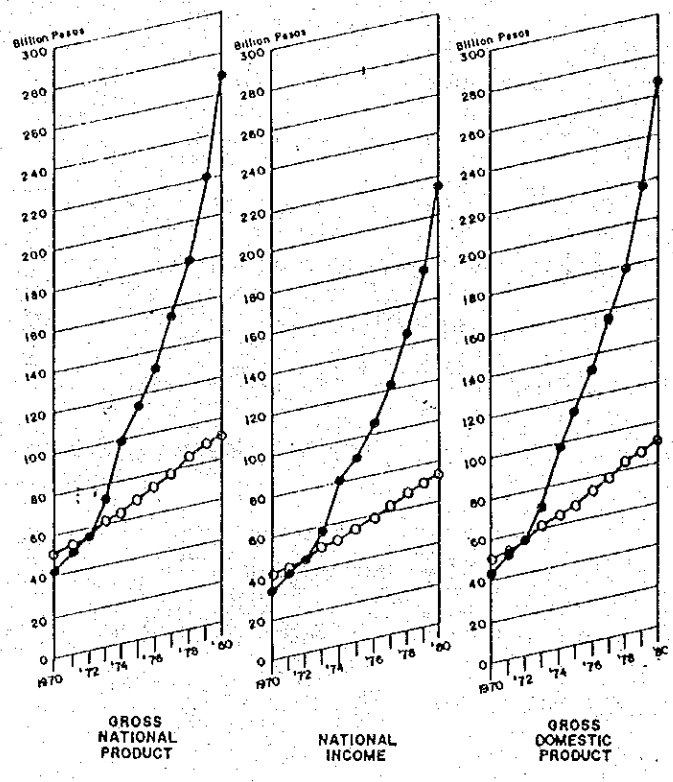
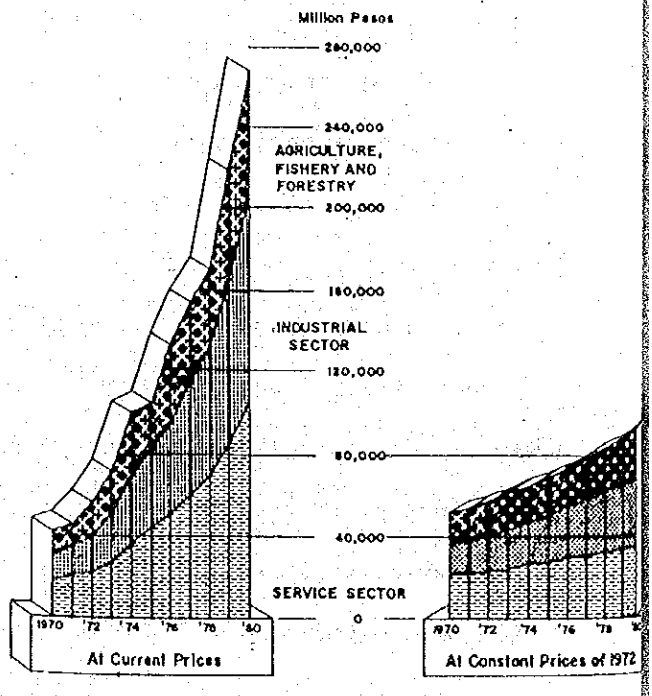


Fig. 2-1-12

GROSS DOMESTIC PRODUCT BY INDUSTRIAL ORIGIN 1970-1980



standards services, product formulation, consultancy and training support by the Philippine Council for Industry and Energy Research and Development.

The allocation for the science and technology plan will increase from 616 million pesos in 1981 (or 0.47 percent of GNP) to 1.5 billion in 1982 (or 1 percent of GNP), 4.16 billion in 1983 and 23.5 billion by 1987. Research and development are also expected to increase annualy, from a share of 35 percent of the total budget for science and technology in 1982, and 65 percent in 1983 to 70 percent in 1987.

2-2 Trends in Philippine Industries

2-2-1 Energy Industry

Total energy consumption reached 92 million barrels of oil-equivalent in 1979, increasing by five (5) to six (6) percent annually, of which about 30 percent is consumed for electricity and 70 percent for vehicles and other industries. Since oil consumption was completely dependent on imports till 1978, new generation systems for nuclear power or geothermal power were loudly called for in order to abate this situation, and a geothermal power system was started in 1979. (Table 2-2-1) Relating to geothermal power, a substantial number of analyses were requested to PIPAC in 1978, 1979 and 1980 regarding environmental pollution due to underground hot spring, though the number has been decreasing sharply in recent years.

If the total energy consumption is assumed to keep increasing by around six (6) percent, the total consumption by energy-consuming industries such as mining, metals, textile, chemicals, machinery, electricity, etc. is expected to increase by six (6) to seven (7) percent, which conforms to past performance.

Table 2-2-1: ENERGY CONSUMPTION

MBOE : Million Barrels of Oil Equivalent

	1977		1978		1979	
	MBOE	%	MBOE	%	BMOE	%
Total Energy	82.9	100	86.7	100	91.9	100
Power						
Hydro	3.6		4.6		5.8	
Oil	17.1		21.0		20.7	
Coal	0.2		0.1		0.3	
Geothermal	--		--		1.3	
Nuclear	--		--		--	
Sub-Total	20.9	25	25.8	30	28.2	31
Non-Power						
Oil	61.4		60.1		63.3	
Coal	0.6		0.8		0.4	
Sub-Total	62.0	75	60.9	70	63.7	69
Oil Consumption						
Imported	78.7		81.5		84.5	
Domestic	--		--		7.8	

2-2-2 Trends in Manufacturing

The output of manufacturing industries increased by 13 or 14 percent annually during the three (3) years from 1974 to 1977 and reached about 68 billion pesos, equal to two trillion yen, in 1977. The output of heavy industry compared to light industry in the past 10 years was around a 50 to 50 ratio. (Table 2-2-2)

The mining and metal industries are major industries in the Philippines. They make a great contribution to the acquisition of foreign currencies through the production and export of gold, silver, copper, nickel, chromium, zinc and salt. In fact, the government as well as the pollution control authority have trouble balancing pollution control with the need for foreign currency income.

The output of plastics, textiles and detergents among chemical pro-

Table 2-2-2: SUMMARY OF GROSS VALUE OF MANUFACTURING OUTPUT

Unit : Million Pesos

	1970	1971	1973	1974	1977
All Manufacturing	15,887	19,251	31,248	47,552	67,826
Heavy Industry	7,221	9,494	14,300	22,879	33,090
Light Industry	8,666	10,117	16,948	24,673	34,736
Mining & Metal					
Coal & Petroleum	1,374	1,758	2,520	6,315	8,274
Non-Metalic Minerals	468	697	1,102	1,657	3,567
Basic Metals	901	781	1,923	2,276	2,748
Metal Products	508	678	1,137	1,290	1,998
Sub-Total	3,251	3,914	6,682	11,538	16,587
Chemical/Machinery					
Chemicals	2,174	2,872	3,299	4,669	6,455
Machinery	114	130	333	628	643
Electric Machinery	517	636	818	1,215	2,466
Transport Equipment	628	868	1,178	1,878	3,386
Sub-Total	3,433	4,506	5,628	8,390	12,961
Food/Tobacco					
Food	3,870	4,834	9,210	14,516	17,623
Beverages	845	1,017	1,250	1,762	3,925
Tobacco	884	995	1,506	2,149	3,190
Sub-Total	5,599	6,846	11,966	18,427	24,738
Textiles/Wood/Leather					
Textiles	1,108	1,441	2,619	3,490	5,154
Wearing Apparel	281	336	345	431	1,406
Wood & Cork	660	796	1,227	1,281	1,742
Furniture	56	67	141	194	410
Paper	509	607	1,064	1,578	2,498
Printing	307	355	505	667	1,003
Leather	33	37	56	60	94
Rubber	404	378	563	806	969
Sub-Total	3,358	4,017	6,521	8,507	13,276
Miscellaneous					
Sub-Total	246	238	451	690	264

ducts have shown a reasonable increase, while electricity and paper products have expanded remarkably though their present output make up only 17 percent of total output. These two (2) sectors are considered to have good prospects. The food industry including agriculture and marine products, beverages and tobacco make up 35 percent of the total output, while

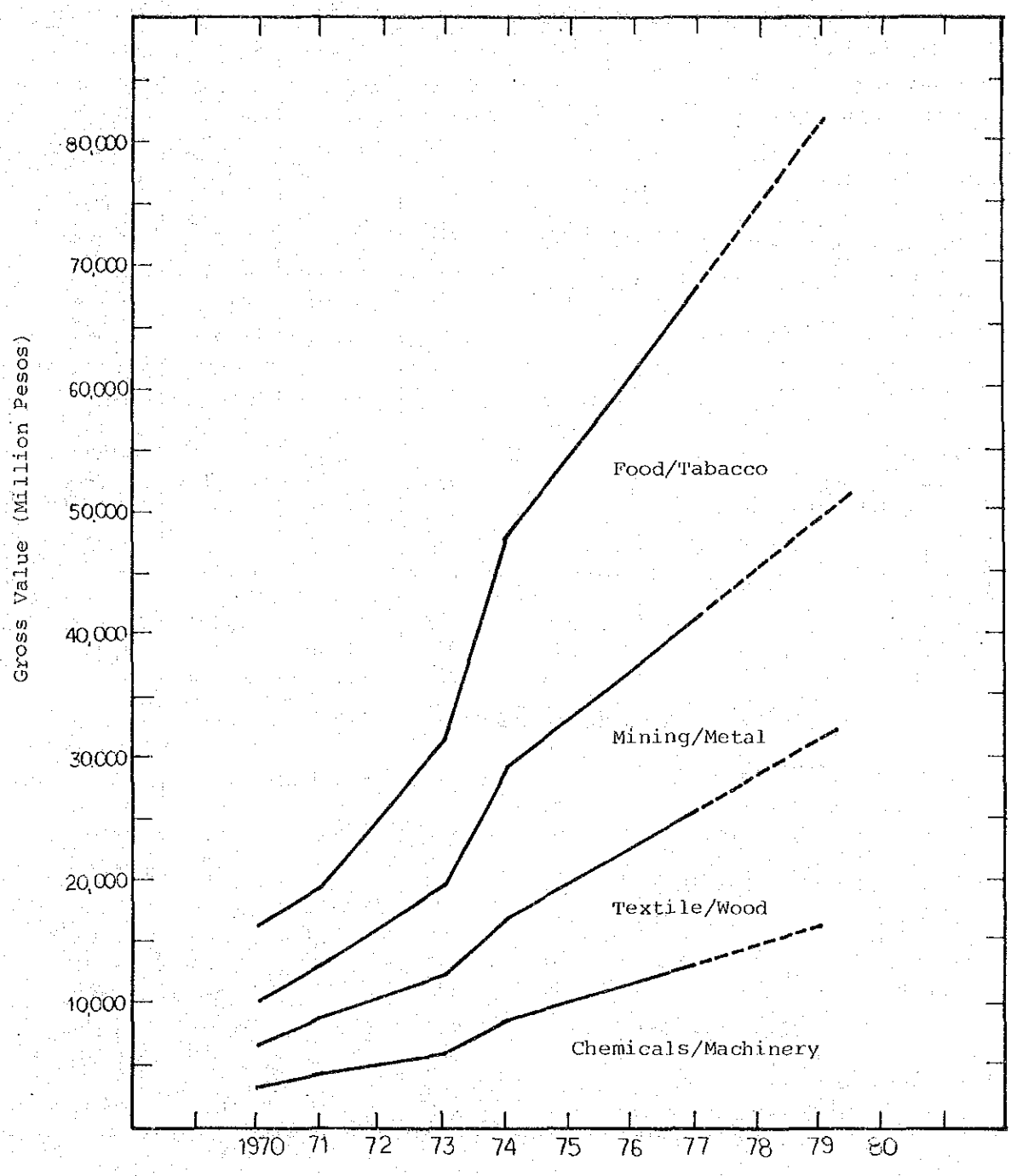


Fig. 2-2-2: GROSS VALUE OF MANUFACTURING OUTPUT

recording an 11 percent annual increase aided in part by export expansion policies. (Fig. 2-2-1) The necessity for analyses of heavy metals and biochemical studies for export licenses is growing rapidly.

2-3 Present Situation of Philippine Chemistry

Judging from the statistical data on the courses of graduates from the universities and vocational schools in the Philippines, the courses have strong commercialism bias. It is probably because of the business-oriented atmosphere of the country, emphasizing things like banking, trade, transportation and commerce. The number of graduates going into medicine and engineering sectors is also great. 70 percent of the all graduates so far are involved in these three (3) sectors. The number of graduates from chemistry departments was a little over 600 persons in 1978, and the total less than 5,000 graduates. It is the equivalent of one person in 10,000 in the Philippines. This ratio is only one-fourth to one-third that of the leading countries like the United States and Japan, a reflection of the shortage of chemists. The training of chemists is one of the aims in the coming five-year development plan. (Table 2-3)

There are two (2) Philippine chemical societies. They are

The Chemical Society of the Philippines

Integrated Chemists of the Philippines

The former is a pure scholastic research institution while the latter functions as a professional intitution. Both institutions are very anxious for young people choose chemistry as a career, which would result in an increase in the number of chemists.

The Chemistry Department of the Unibersity of the Philippines, the highest-level and largest university in the Philippines has chemical courses that differ considerably from those in Japanese universities.

Table 2-3: NUMBER OF GRADUATES

Field of Stydy	No. of Graduates in 1978	Total No. of Graduates up to 1979
Undergraduate	103,625	1,024,025
Commerce and Business	28,107	402,409
Engineering and Technology	12,401	204,096
Medical Science	28,534	119,185
Teaching Training (Education)	8,972	83,863
Arts and Science	9,538	79,537
Agriculture	7,742	56,242
Nautical Service	2,528	30,203
Law and Foreign Service	1,787	22,719
Food and Nutrition	2,096	11,664
Misic and Fine Arts	1,291	9,343
Chmistry	629	4,764
Masteris Program	1,507	27,707
Doctoral Program	59	2,618
Technical/Vocational	69,307	127,753

Population of the Philippines

47,914,000 in 1980

42,071,000 in 1975

2-4 Present Situation of Philippine Analytical Laboratories

As far as looking around the institutes and the laboratories in Manila area which are taking a role of analytical function, the analytical devices are well furnished and relatively well equipped as shown in table 2-4. Natural Science Research Center in the University of the Philippines has the various high level equipment such as an electron microscope and a nuclear magnetic resonance analyser granted as war reparations by Japan and also the Ceramic Center in the National Institute of Science and Technology sets off the activities of analytical equipment under the advisory promotion by Japanese specialists. The laboratory of the Pollution Control Center installes many kinds of analytical equipment as in the use of appropriate analytical purposes for the pollution monitoring.

But the higher grade equipment seems to be seldom used as a few times in a year due to the complicacy of the sample preparation prior to analysis and due to the difficulty of common usage among the institutes and laboratories. Some of the analytical equipment is unattended for several months after going out of order caused by the insufficiency of spare parts and maintenance.

Table 2-4: ANALYTICAL EQUIPMENT INSTALLED IN SEVERAL INSTITUTES

◎ : Research Scale Equipment
○ : Common Scale Equipment

Industry/Laboratory / Major Equipment	PIPAC & Ateneo de Manila University	Natural Science Research Center of UP	National Inst. of Science & Technology (Ceramic Center)	National Pollution Control Commission (Laboratory)
Electron Microscope	—	◎	◎	—
X-ray Diffrax Analyzer	—	◎	◎	—
Mass-Spectrograph	○	◎	—	—
Nuclear Magnetic Resonance	○	◎	◎	—
Thermal Analysis System	—	—	○	—
Infrared Spectrophotometer	○	◎	○	○
UV-VIS Colorimeter	○	○	—	○
Atomic Absorption Spectrometer	○	○	◎	○
Colorimeter	○	○	○	○
Elemental Analyser	○	○	—	○
Gas Chromatograph	○	◎	○	○
Liquid Chromatograph	○	—	—	—
Densitometer	○	○	—	—
Polarograph	○	—	—	—

2-5 Foundation and History of PIPAC

2-5-1 Ateneo de Manila University

Ateneo de Manila University where PIPAC was founded and is still located today is one of the oldest universities in Asia. It was founded as a public primary school in 1859 by the Spanish Jesuits and developed into a liberal art college in 1958. It was separated from the Spanish Jesuits in 1901 and was administered by the American Jesuits from 1921. After the campus was completely destroyed in World War II , the college moved to its present site in 1951 and has been under the administration of the Philippine Jesuits since 1958.

Since 1959 the college has developed into a university, with schools of science, law and commerce and graduate schools in these same fields. Various independent research institutes like the Institute of Philippine Culture, the Manila Observatory, Loyola School of Theology and East Asian Pastoral Institute were also founded. PIPAC is one of the newest independent institutes.

2-5-2 PIPAC

The Chemistry Department of Ateneo de Manila University was established in 1960 and since 1965, when the department building was constructed, the number of professors has increased to seven (7) along with an increase of the number of courses and graduate courses in chemistry and chemistry education established. Immediately after the completion of the building, the department started to service requests for technical cooperation from Philippine industry: the study of utilizing materials and byproducts; monitoring

and control of environmental pollution; training seminars for industry; advice on quality control, etc. It was, however, impossible for the chemistry department to fulfill all these requests and thus a new institute came to be earnestly desired to answer requests from Philippine industry.

A feasibility study was carried out concerning the establishment of an independent chemistry research institute by the Asia Foundation Fund in 1971, which presented the possibility of a management base with the following data.

Type of chemistry related service	Enterprises requesting service (%)
Chemical Analysis	75 %
Research & Development	75 %
General Counselling	70 %
Personnel Training	41 %
Quality Control Services	25 %

In November 1974, the Alexander Von Humbolt Foundation in West Germany resolved to donate chemical analysis equipment worth DM 257,197 at current prices (₱ 731,371, at contemporary prices) to Ateneo de Manila Univ. for the establishment of an "Institute for Chemical Analysis, Applied Research and Technical Training" (tentative name). This institute was approved as the "Philippine Institute of Pure and Applied Chemistry", a non-stock, non-profit organization, by the National Science Development Board (the National Science and Technology Authority today) as of April 3, 1975 and started operation from August 4 with a donation of 10,000 pesos from Ateneo de Manila University.

Since then PIPAC has been independently managed through its own service accounts except for donations of books and documents worth 69,116 pesos from

the Philippine Eslon Manufacturing Corp. and stock in the Mabuhay Vinyl Corp. worth 101,950 pesos at current prices from that company.

2-6 Present Situation of PIPAC

2-6-1 Organization

PIPAC is supervised by its Board of Trustees as shown in fig. 2-6-11. The Board of Trustees consists of three (3) professors of Ateneo de Manila Univ. and six (6) representatives from industry, as shown in table 2-6-1, which shows that the establishment as well as activities of PIPAC are centered on requests and demands from industry. The excutive director and other three (3) directors are professors of Ateneo de Manila Univ., Chemistry Department, which indicates how PIPAC's activities up to now have been supported by their scholarship and experience. The number of specialist staff is 21 altogether; 19 in the research & development and the analytical services departments (three (3) are part-time workers) and two (2) in the general services department. The organization consists of the three (3) service departments, explained in sec. 2-6-4, and one (1) administration department. The future organization of PIPAC as of 1984, at the time of completion of this project when the new start with new facilities is planned, and the one as of 1988 when PIPAC's five year program is accomplished as shown in table 2-6-12 and 2-6-13 respectively.

2-6-2 Building

Since its establishment, PIAPC has been accomodated in the second and third floows of the chemistry building of Ateneo de Manila University. The floor area occupied is only 125 m^2 including one (1) office and two (2) research laboratories. Therefore, PIPAC's services such as chemical research and analysis, training and seminars, etc. are carried out in

Fig. 2-6-11: PIPAC ORGANIZATION CHART IN 1981

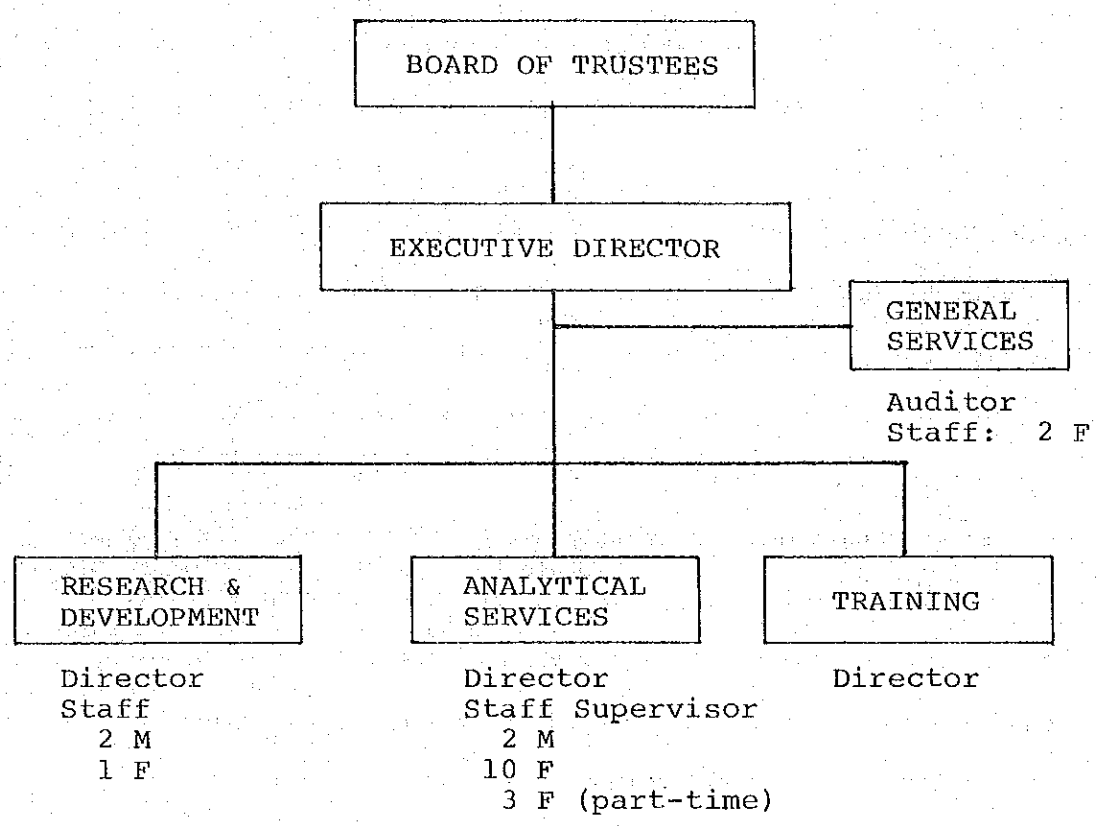
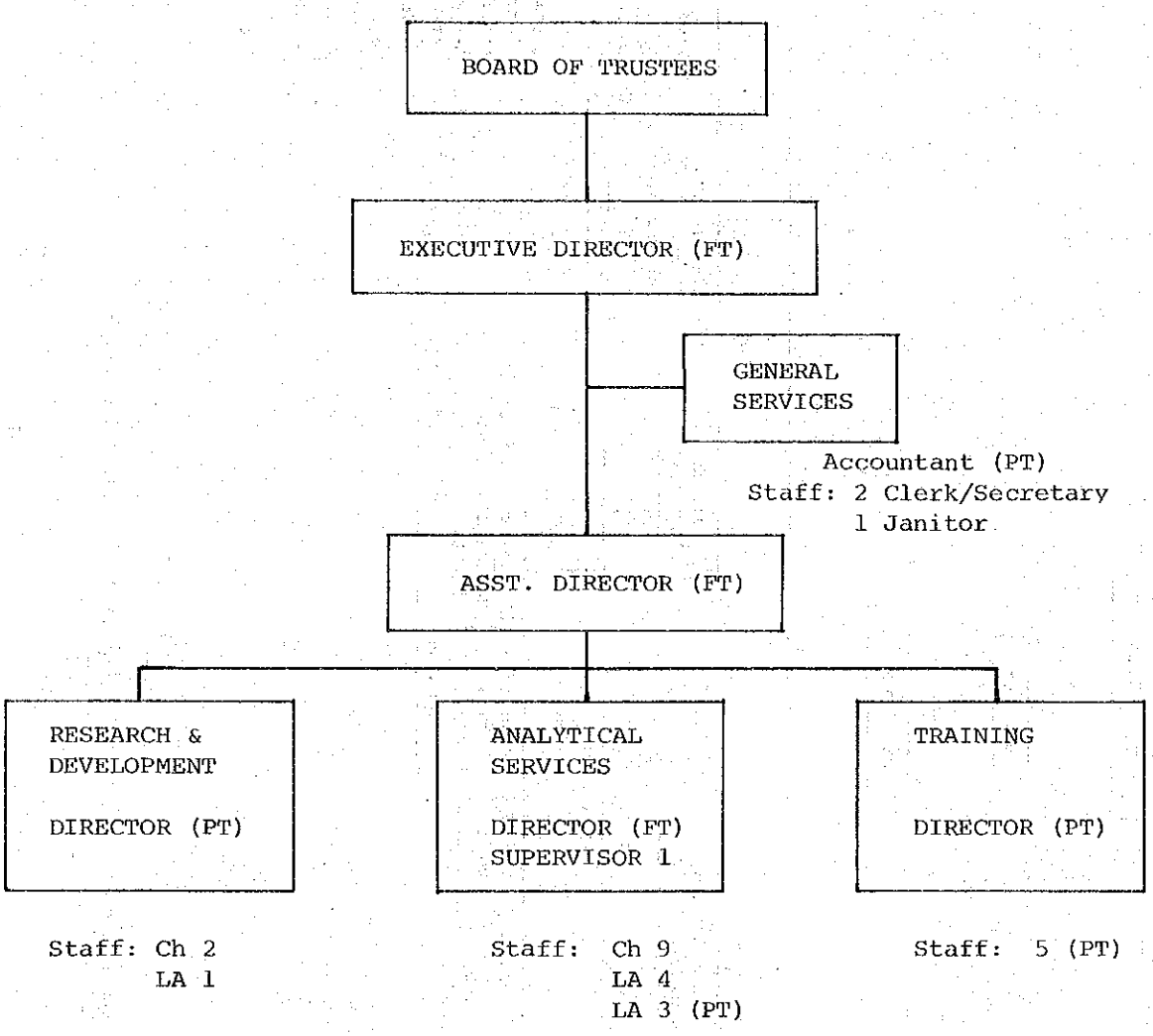


Table 2-6-1: MEMBERS OF THE BOARD OF TRUSTEES

Chairman	Magsaysay Lines, Inc.
Vice-Chairman	Grand Farms, Inc.
Secretary	Ateneo University
Treasurer	Ateneo University
Institute Director	Ateneo University
Member	Mabuhay Vinyl Corporation
Member	Caltex Philippines, Inc.
Member	Philippine Packing Corporation
Member	National Development Corporation

Fig. 2-6-12: PIPAC ORGANIZATION CHART IN 1984



Note: FT stands for Full Time

PT stands for Part Time

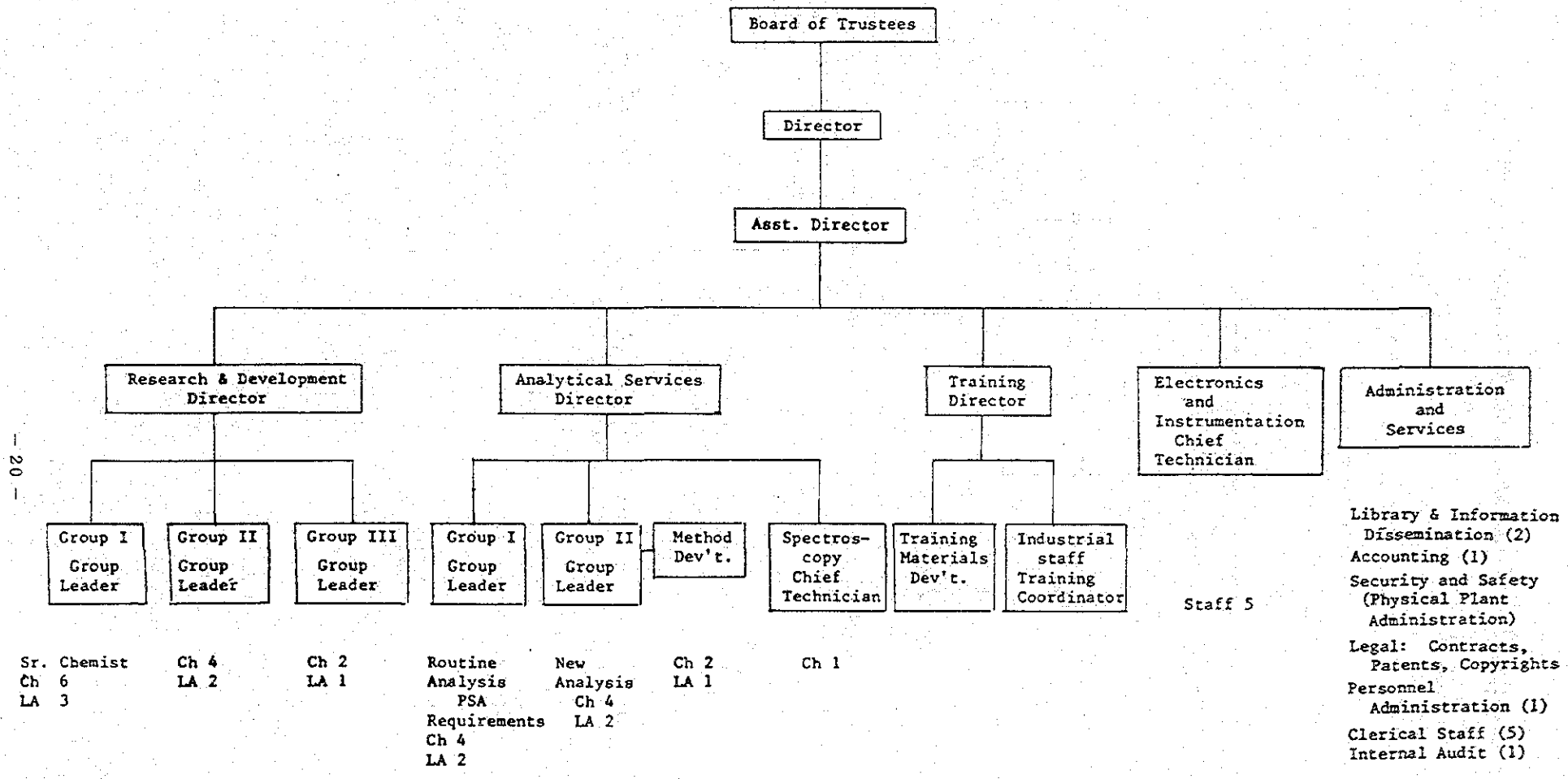


Fig. 2-6-13: PIPAC ORGANIZATION CHART IN 1988

coordination with the university schedule in the use of the chemistry building. PIPAC's activities are severely limited because the chemical laboratories are used by the chemistry department as well as other science departments and the lecture rooms are used as ordinary classrooms. Rental fees now being paid by PIPAC to the university come to 12,000 pesos (about 340,000 yen) a year including electricity and water.

2-6-3 Analytical Equipment

PIPAC's analytical equipment consists mostly of that donated by the Humbolt Foundation. It is well maintained and operated. Major equipment is as follows:

(1) Atomic Absorption Spectrophotometer

(2) Nuclear Magnetic Resonance Spectrometer

(3) Mass Spectrometer

(4) Gas Chromatograph - 2 units

(5) Liquid Chromatograph

(6) Puls Polarograph

(7) Automatic Fraction Collector

And the equipment owned by the university chemistry department is jointly used by PIPAC.

2-6-4 Services

1) Analytical Services

The analytical services department has seen the greatest demand since the opening of PIPAC. Sample treatment services increased to 136 percent with an income increase of 167 percent from 1978 to 1981. Along with this the size of the staff has increased from 12 to 17. Still the present available services fulfilled are 466 compared with 688 analysis requests;

one-third of the requests have to be rejected because of limitation on the availability of building space and capacity of the analytical equipment, and the shortage of personnel.

Table 2-6-41 and fig. 2-6-41 show how these analytical services contribute to the Philippine government and industry. As is shown, the categories in greatest demand are food, agriculture and marine products. They make up 50 to 70 percent of total demand while pollution is next with about a 20 percent share. Table 2-6-42 and fig. 2-6-42 show trends in analytical services categorized by analytical methods, which indicate that instrumental analysis is predominent but that hand analysis sometimes makes up 50 percent of total analyses though the percentage fluctuates year by year. Of analytical methods, metal analyses are most frequently performed by the atomic absorption spectrometer, whose operation performance reaches 103 percent. Analyses of poisonous content in the air and agricultural plants including weed killer and insecticides by the gas chromatograph are also frequent with an operation performance of 86 percent per unit.

It is a fact that the improvement of the analytical equipment and the increase of the number of personnel cannot be attained until the physical problem, the limitation of present space in PIPAC, is solved.

2) Training and Seminars

In chemistry departments in Philippine universities, general and theoretical chemistry predominates. Hand analysis using glassware predominates even in analysis courses. Students seldom have the opportunity to learn highly technical analytical methods actually using analytical equipment. It is only natural that even the graduates of the university chemistry departments lack knowledge and experience, with common analytical

Table 2-6-41: TENDENCY OF ANALYSIS CATEGORY

Category	Client	Nos. of Analysis Samples 1978	1979	1980	1981	Total
Pollution	Automobile	2	--	1	62	
	Geothermal	3,346	1,439	753	11	
	Government Agency	456	623	1,483	1,611	
	Consultant Group	21	15	124	344	
	Sub-Total	3,825	2,077	2,361	2,028	10,291
Food	Food	87	24	177	65	
	Fish/Marine	7	382	1,227	986	
	Agriculture	42	28	--	5	
	Biochemistry	2,665	4,449	1,997	6,072	
	Sub-Total	2,801	4,883	3,401	7,128	18,213
Chem. Ind.	Petroleum/Gas	38	11	125	72	
	Alcohol/Sugar	38	2	53	1	
	Detergent/Soap	44	37	35	70	
	Plastics	--	4	6	252	
	Salt Industry	--	11	--	--	
	Sub-Total	120	65	219	395	799
Ceramics	Ceramics	18	8	112	--	
	Glass/Glass Fiber	39	54	--	--	
	Sub-Total	57	62	112	--	231
Textile	Fiber	34	122	10	--	
	Textile	--	10	33	20	
	Sub-Total	34	132	43	20	229
Mining	Mining	8	84	--	34	
	Metal	--	13	65	39	
	Sub-Total	8	97	65	73	243
Drugs		371	334	230	435	1,370
Medical		2	--	--	--	2
Electrical		--	--	6	24	30
Marketing		297	163	344	147	951
Misc.		44	49	232	46	371
Total Number of Samples		7,559	7,862	7,013	10,296	22,730

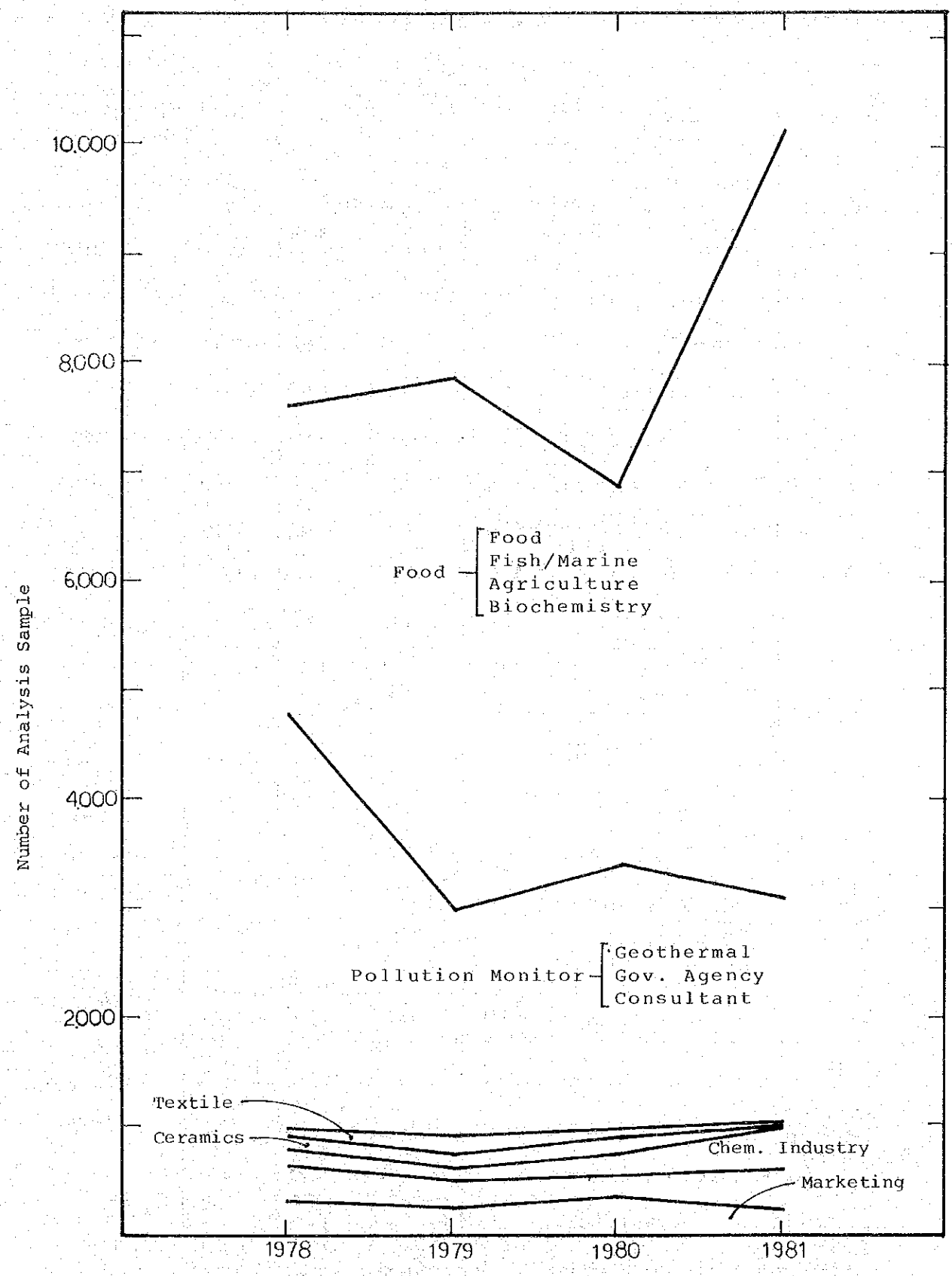


Fig. 2-6-41: TENDENCY OF ANALYSIS ACTIVITIES IN ACCONDANCE WITH CLIENT CATEGORY

Table 2-6-42: TENDENCY OF THE NUMBER OF TREATED SUMPLES AND INCOMES

Income: 1000 Pesos

	Analytical Method	1978		1979		1980		1981	
		Sample No.	Income	Sample No.	Income	Sample No.	Income	Sample No.	Income
Equipment Analysis	Atomic Absorption Spectrophotometery	1,945	106	1,631	99	2,654	226	2,185	192
	Gas Chromatography	1,030	51	1,708	90	1,102	92	1,008	86
	Infrared Spectrophotometry	71	5	78	6	140	20	191	21
	UV-VIS Spectrophotometry	1,347	77	735	48	1,306	91	992	79
Hand Analysis	Gravinietry	2,492	50	3,306	73	1,404	33	5,298	122
	Classical	674	37	404	26	407	24	622	44
	Total Number of Samples	7,559		7,862		7,013		10,296	
	Total Income		326		342		486		544

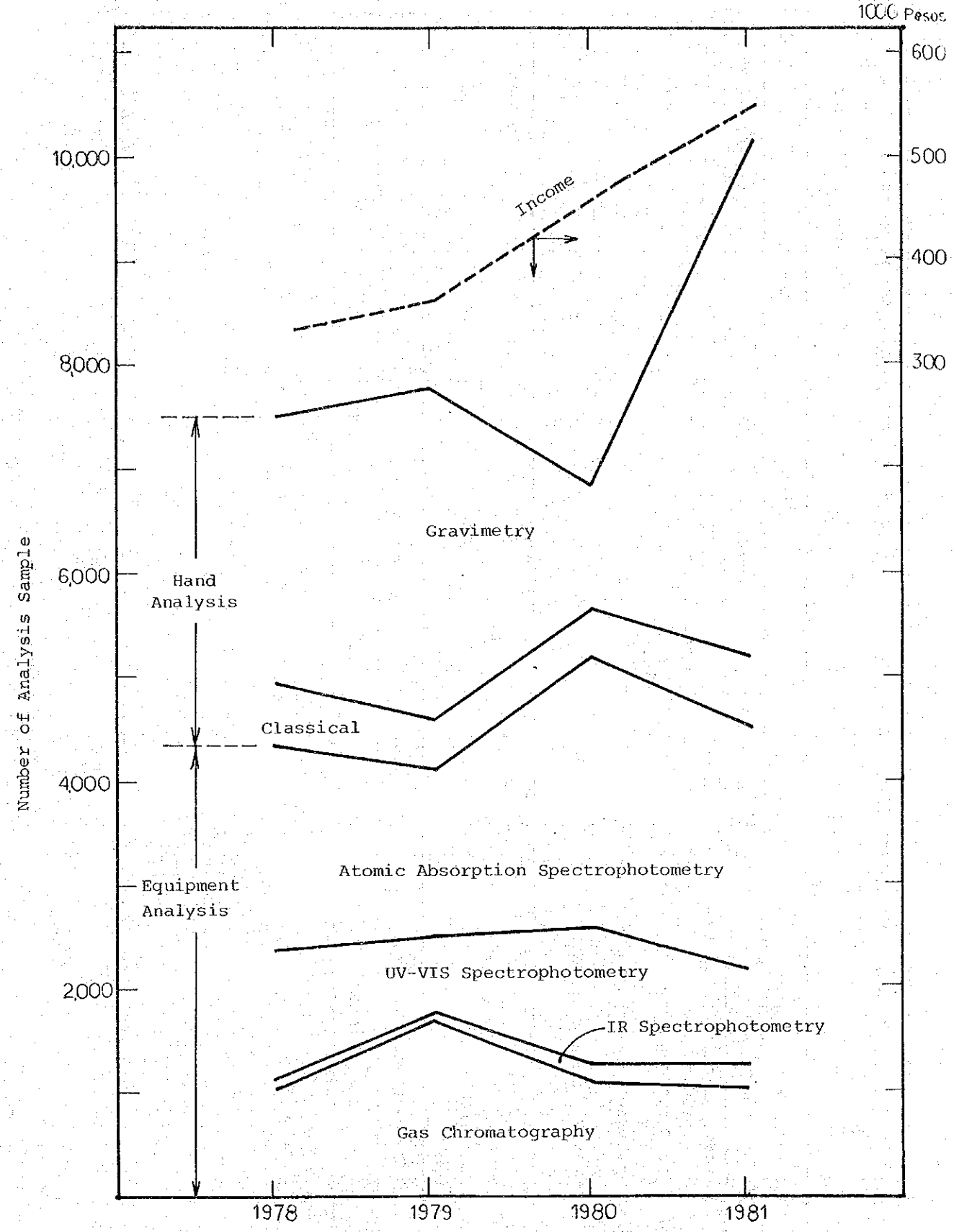


Fig. 2-6-42: TENDENCY OF ANALYSIS ACTIVITIES IN ACCORDANCE WITH ANALYTICAL METHOD

equipment such as the gas chromatograph, atomic absorption spectrophotometer, their analytical theory, operation methods, data analysis, etc.

However, the situation demands the use of these new analytical instruments for the modernization of Philippine Industry, quality improvement of products, study of marine products for export, environment conservation, etc.

PIPAC has had its analytical equipment and laboratories quite open to the public since its establishment, held training services and seminars to meet the demand for improving analytical technique and granted deplomas counter-signed by the dean of the chemistry department to those who completed training and seminar courses. The total number attending from 1974 to 1981 was 359, 52 to 94 per year recently, as shown in table 2-6-43. Training and seminar services are also severely limited in space, equipment and personnel, managing by utilizing weekends for training and seminars.

(3) Research and Development

PIPAC has had the role of advisor or consultant to the Philippine government and manufacturers on the subject of improvement of chemical analytical methods, as well as assisting from the chemical aspect in solving quality troubles of products. PIPAC has also been active in collecting data on environmental conservation and microanalysis procedures.

This department dealt with 17 cases from 1977 to 1980, of which two (2) were consulting services, four (4) solving problesm of quality improvement and nine (9) environmental conservation and pollution.

2-7 Future Prospects of PIPAC

Industrial trend in the Philippines have already been explained in sec. 2-2, while the PIPAC's activity does not accord with the industrial progress.

Table 2-6-43: THE NUMBER OF PARTICIPANTS AND COMPANIES REPRESENTED OF PIPAC SEMINAR-WORKSHOPS PER YEAR

SEMINAR-WORKSHOPS ON:		1974	1975	1976	1977	1978	1979	1980	1981	Total
GAS CHROMATOGRAPHY	No. of Participants	-	10	46	17	-	41	29	32	175
	No. of Companies	-	2	18	11	-	20	20	20	91
ATOMIC ABSORPTION SPECTROPHOTOMETRY	No. of Participants	10	-	17	45	-	-	18	24	114
	No. of Companies	10	-	8	16	-	-	11	12	57
INFRARED SPECTROPHOTOMETRY	No. of Participants	-	-	4	-	-	8	1	20	33
	No. of Companies	-	-	2	-	-	2	1	7	12
UV-VIS SPECTROPHOTOMETRY	No. of Participants	-	-	-	-	-	5	-	18	23
	No. of Companies	-	-	-	-	-	1	-	10	11
NUCLEAR MAGNETIC RESONANCE SPECTROSCIPY	No. of Participants	-	-	-	-	-	-	4	-	4
	No. of Companies	-	-	-	-	-	-	2	-	2
EDPITAF SEMINAR-6 Methods of Analysis	No. of Participants	-	-	10	-	-	-	-	-	10
	No. of Universities Represented	-	-	8	-	-	-	-	-	8
TOTAL NO. OF PARTICIPANTS		10	10	77	62	-	54	52	94	359
TOTAL NO. OF COMPANIES		10	2	36	27	-	23	34	49	181

One reason is that major industries have their own analytical laboratories and are not highly dependent on outside research and analytical institutions. However, there are strong expectations that PIPAC develop in the future in the following area:

(1) As an analysis and investigation organization as a neutral third party like in analytical services for heavy metals or poisonous contents in agricultural and marine products

(2) As a training organization for chemistry technicians according to the training program for natural scientists in the coming Philippine five-year science and technology development plan

(3) Participation in projects like the energy conversion project in the Philippine five-year development plan starting in 1983 which will aim to produce gradual independence from petroleum imports

(4) Consulting services in quality control for small companies, or technical development of products like daily necessities and food

Considering this background, future prospects for each service department of PIPAC is looked at hereafter.

2-7-1 Analytical Services

It has already been stated that one-third of the analysis requests are turned down because of limitations of personnel, equipment and laboratory space. As an authorized analytical laboratory, PIPAC is now engaged, in a neutral position, in authorization of analysis of poisonous contents in marine products like the mercury content of tuna. The number of analytical services is expected to increase along with developments in agriculture, marine products and food industries. Requests for analysis are also expected to continue for things like the examination of residual poisons in weed killers and insecticides or safety inspections of food exports.

Of analytical equipment, there are at present four machinery most frequently used; the atomic absorption spectrophotometer, gas chromatographs, UV-VIS colorimeter, infrared spectrometer. Two (2) sets of these five (5) belong to Ateneo de Manila University. Ten (10) new pieces of equipment are to be granted, and PIPAC will own 13 pieces of equipment after the grant. That means the total capacity of PIPAC is expected to increase threefold over the present, though the level of improvement will depend on the equipment.

It is necessary to have a well trained staff skillful in the use of equipment in order to utilize the full capacity of analytical equipment. Considering the balance of the staff and the equipment, it should not be very difficult to attain full operation in three (3) years from the onset of the new organization what with the competance of Philippine engineers and results of on-the-job training by the PIPAC leadership.

Analytical services play a key role at present in PIPAC. They make up 75 percent of the total sales amount and are expected to continue regular development and provide a stable income in the future. Table 2-7-1 is an estimate of the future development of the analytical services classfied according to instrumental analysis and hand analysis.

Though the types of equipment differ for analysis and for training, the training type equipment can be used without difficulty in analytical work. It is highly recommended that training type equipment be used for analytical services, training and seminars, and research and development.

2-7-2 Training and Seminars

Young engineers and technicians in the Philippines are eager to acquire specialty qualifications as a licensed capacity. They are active in attending training sessions and seminars even in the evenings or on weekends. As it is expected that many engineers will wish to join the

Table 2-7-1: FORECAST OF ANALYTICAL SERVICES

Methods \ Year	Past Records				Future Plan			
	Nos. of Equip.[1/]	Nos. of Samples 1979	1980	1981	Nos. of Equip.[3/]	Nos. of Sample 1984	1985	1986-
(Equipment Analysis)								
Atomic Abs. Spect.	1	1,631	2,654	2,185	1+(3)	3,000	4,500	6,000
Gas Chromatograph	2	1,708	1,102	1,008	2+(3)	1,500	2,000	3,000
UV-VIS Spectrophoto	1[2/]	735	1,306	992	(2)	2,000	2,500	3,000
IR Spectrometer	1[2/]	78	140	191	(2)	200	400	600
Other Equipment		-	-	-		100	200	400
Sub-total		4,152	5,202	4,376		6,800	9,600	13,000
(Hand-Treat Analysis)								
Classical Analysis		404	407	622		1,000	2,000	3,000
Gravimetric Analysis		3,306	1,404	5,298		4,000	5,000	7,000
Sub-total		3,710	1,811	5,920		5,000	7,000	10,000
Grand Total (samples)		7,862	7,013	10,296		11,800	16,600	23,000
Income (₱1,000)								

Notes: 1/ Existing analytical equipment

2/ Analytical equipment owned by Ateneo de Manila University, which shall be returned to the university.

3/ Analytical equipment in the parenthesis shall be newly granted.

training sessions and seminars held by PIPAC, a substantial number of enterprises support their employers' training, which will result in a large number of participants in the training sessions and seminars.

In fact, lecture rooms and laboratories in the present building are occupied most of the time by the students of the university who take chemistry courses. The seminar schedule is only three (3) days per seminar, with six (6) seminars a year. As the amount of training type equipment is also insufficient, the average number of participants in one(1) seminar is only 16, far less than the capacity of the training and seminar department. In addition, these seminars are scheduled not to interfere with the analytical services or the analysis hours for research and development. Some seminars are held in the evenings or on weekends.

Based on the space expansion program and improvement of the analytical equipment and research and analytical laboratories, it will be possible to plan a schedule as follows:

Atomic absorption spectrophotometer	3 seminars a year
Gas chromatograph	3 "
UV-VIS Colorimeter	2 "
Infrared spectrometer	2 "
Special analyses like mass spectrometry	2 "
Total	12 seminars a year

Training programs will also be improved not only for operating the analytical equipment but in the preparation of samples. Then 24 persons on the average will be able to attend one (1) seminar. It means the training capability of PIPAC will increase to three times as much as at present. The problem is to obtain a sufficient number of professors in PIPAC or leading chemists for the seminars. Therefore, it is suggested the number of seminars be increased gradually, for example, 8 seminars in the first year, 10 in the second and 12 in the third year.

Along with the services of the training and seminar development, active public relations and appeals to the governmental organizations or related companies are recommended for the procurement of seminar participants and to stabilize operations. Assuming that analytical engineers who are trained by these training and seminars will play active roles in various sectors like food, mining, metal, energy, agriculture and marine industries or environmental conservation in accordance with the five-year development plan in the Philippines, the contribution of the training and seminar department is no small thing.

2-7-3 Research and Development

Major services in research and development by PIPAC in the past, like the study of the lack of strength of polypropylene ropes, quality improvement of alcohol, advice on the quality of ethylene glycol, helped to solve problems for small and medium size companies. Income was not more than five (5) percent of the total income and the staff involved was also small in number.

However, the purpose of the National Science and Technology Authority (NSTA) in the Philippines is to accelerate research and development in the Philippines, to catch up with the scientific and technological level of the world's leading countries, and to form a firm industrial foundation by the investment of 4 to 23 billion pesos annually in the five-year development plan starting in 1983. NSTA is strongly urging the private sector to participate in this program. PIPAC plans to put emphasis on research and development activities in conformance with this program with the following plans expected for research and development projects.

(a) Energy development project

- applied research on mixtures of alcohol and gasoline for vehicles

- small size energy production research utilizing biochemical reactions in botanical wastes (Biomass)
- development of the production of alcohol or ethylene glycol from sugar cane

(b) Support for problem solving (Trouble shooting)

- quality improvement of cosmetics
- prevention of undesirable residues and contamination in canned products
- consultation service to small companies such as the recommendation of detergents

(c) Consulting service

- data collection and analysis concerning environmental conservation
- consulting service to governmental organization and pollution generating industries by standardizing microchemical analysis method

As for the future prospects of research and development by PIPAC, participation to the national energy development project over a long period will be the major project, and problem solutions or consulting services to the small industrial sectors will also be important contributions that are highly recommended.

In view of the analytical equipment planned as grants, research availability is expected to make great progress with the mixture separating equipment, such as a droplet countercurrent extractor, a refrigerated centrifuge, a high performance liquid chromatograph with the combination of an infrared and UV-VIS spectrometers. The research and development department budget has reached as much as ₱ 30,000 to ₱ 50,000 so far, which can increase to ₱ 200,000 in 1984 and ₱ 700,000 in 1987 in combination with PIPAC's personnel disposition program.

2-7-4 Establishment of Electronics and Instrumentation Group for Analytical Equipment

Present maintenance conditions for analytical equipment in the Philippines are insufficient, as stated in sec. 2-4. It is good time to establish an electronics & instrument group to serve as a consultant or advisor on analytical equipment. Its services are --

(a) to provide consulting services for the procurement of analytical equipment, its specifications, accessories and spare parts to eliminate future problems

(b) to give proper advice on regular inspections or the breakdown of the analytical equipment to improve its performance

(c) to maintain the analytical equipment of PIPAC by repairing or assembling small accessories in the instrument room

This electronics & instrument group is to render the function directly as the consultant or advisor for groups other than PIPAC and indirectly for reducing maintenance costs in requesting these repairs from foreign countries. Though this group may not be able to serve outside interests soon after the reestablishment of PIPAC due to test-runs of new equipment and establishment of a stable organization, they are expected to perform as a sort of service function as well as a training and seminar function in maintenance methods.

2-7-5 Organization and Disposition of Personnel Program of PIPAC

A professor of Ateneo de Manila Univ. serves concurrently as the director of PIPAC at present, as was mentioned in sec. 2-6-1. It is indispensable to appoint a full-time director for proper management in accordance with the future expectations of PIPAC. PIPAC's future prospects have to be taken into consideration when planning organizational

structure.

The personnel program shall be planned to achieve expansion of the staff in conformance with the future development of the analytical services, training and seminar, research & development, and electronics & instrument group. General services shall have a manpower program aiming at self-sufficiency.

CHAPTER 3 OBJECTIVES OF THE PROJECT

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3-1 Objectives of the Project

PIPAC cannot fulfill the requests from Philippine industry for chemical analyses, technical training and research and development services on account of the limitations like the shortage of its staff and equipment and the available building space. An improvement and expansion program of the staff and equipment cannot be carried out because of the limited space in the chemistry building and the present situation that PIPAC uses other required spaces in intervals in the university schedule. In order to improve this present situation and to have PIPAC respond to the growing needs of Philippine industry, the government of the Philippines has requested a grant of a new administration and laboratory building and analytical equipment to the government of Japan. The objective is to analyze the substance of the request and to plan the best suitable basic design based on the social and economic effect within the limit of Grant Aid of the government of Japan for this project.

3-2 Substance of the Project

The request from the government of the Philippines as for the building and analytical equipment, contents of the study conducted by the basic design study team and the basic items agreed on the meetings are summarized as follows.

3-2-1 Building

1) Request

(1)	floors	4-storeys
(2)	approximate total floor area	3,080 m^2

others	Patio-type construction, with the second floor to be the main floor

2) Basic design study

(1) floors	3-storeys are recommended to shorten the construction period, and considering an elevator will not be installed because of maintenance and running costs
(2) total floor area	Around 3,000m^2 is reasonable, calculated from the space per staff member based on the personnel schedule, the space of each research and analytical laboratories, and the number of laboratories.
(3) others	Patio type construction with natural ventilation is reasonable since the full air-conditioning cannot be applied because of the initial and running costs. It is hard to design the second floor as the main floor due to the site condition, the first floor is recommended to be the main floor.

3) Agreements

(1) floor	3-storeys
(2) total floor area	2,966 m^2
(3) others	Patio-type construction with the first floor to be the main floor

3-2-2 Analytical Equipment

List of Major Equipment

1) Request		3) Agreement	
Equipment	Sets	Equipment	Sets
High Performance Liquid Chromatograph with Data Processor	1	High Performance Liquid Chromatograph with Data Processor	1
Training Infrared Spectrometer	3	Infrared Research Spectrometer	1

1) Request		3) Agreement	
Equipment	Sets	Equipment	Sets
Infrared Data Station		Training Infrared Spectrometer	1
Training Atomic Absorption Spectrometer	3	Training Atomic Absorption Spectrometer	3
Training Gas Chromatograph	3	Training Gas Chromatograph	3
Training Colorimeter	5	UV-VIS Colorimeter	2
Spectrograph	1	(canseled)	0
Elemental Analyzer Kjeldahl Apparatus	1	Elemental Analyzer	1
Microcomputer with up to 16 Terminals Interface-able with Chemical Instrumentation	1	Microcomputer	1
Spectrodensitometer	1	Spectrodensitometer for Thin Layer Chro-matography	1
Laboratory Scale Fermentor	1	Laboratory Scale Fermentor	1
Ultracentrifuge	1	Refrigerated Centri-fuge	1
Freeze Dryer	1	Freeze Dryer	1
Droplet Countercurrent Extractor	1	Droplet Countercurrent Extractor	1
Equipment for Instrument Repair	1	Equipment for Instrument Maintenance and Trouble Shooting	1
Gas Chromatograph-Mass Spectrometer with Data Processor	1	(canseled)	0
Differential Scanning Calorimeter			1
Wiley Mill	1	(canseled)	0

List of Auxiliary Equipment

1) Request	3) Agreement	
Equipment	Equipment	Sets
Balances of Various	Automatic Analytical Balance	6
	Micro Balance	1
	Rough Balance	4
Laboratory Ovens and Furnances	Dry Oven 250°C	6
	500°C	2
	Muttle Furnace	2
Automatic Water Distilation and Storage Equipment	Automatic Water Still	2
Cold Storage Equipment	Cold Storage Equipment	1
Metal and Woodworking Machine Tools	Metal and Woodworking Tools	1
Audio-Vesual Equipment	Audio-Visual Equipment	1
Library Books and Journals	(canseled)	0
Laboratory Glassware, Porcelaine-ware and other minor laboratory equipment and supplies	Laboratory Glassware, Porcelaine-ware and other minor Laboratory equipment	1
Chemical Reagents and Standards	Chemical Reagents	1

2) Basic design study

The study team conducted researches on the types of existing equipment of PIPAC and the frequency of their use, other chemical laboratories, and the present situation of chemistry analytical equipment in the Philippines. The study team had discussions with the Philippine officials based on the study results and made necessary amendments of the request, whose agreement is shown in the above list. As for the details of the basic study and the principles of selecting the equipment, sec. 2-5, 2-6 and sec. 5-8 shall be referred respectively.