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CHEMICAL INDUSTRIES ADVISER,

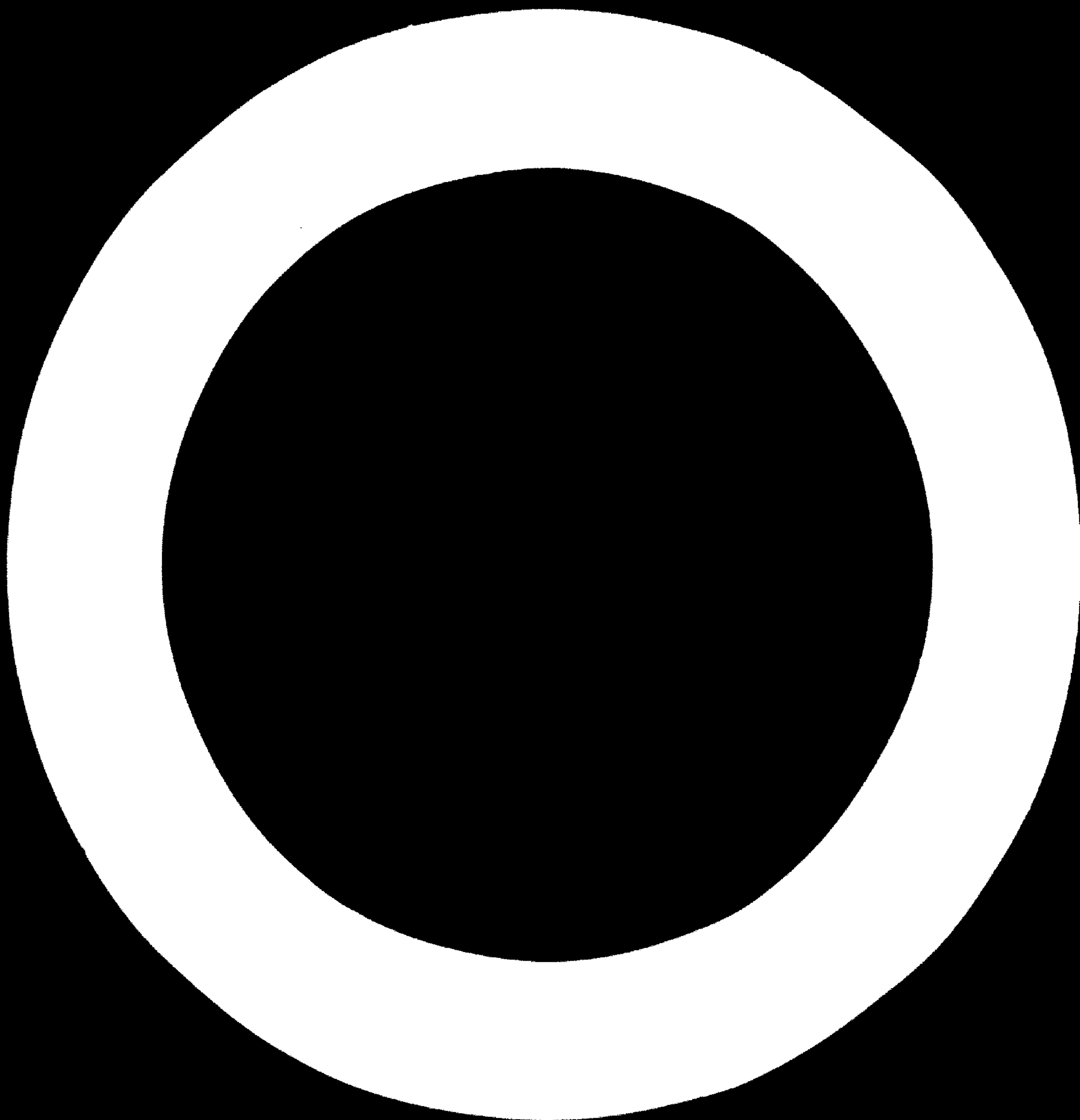
DP/INS/72/054

INDONESIA.

TERMINAL REPORT

Prepared for the Government of Indonesia by the
United Nations Industrial Development Organization,
executing agency for the
United Nations Development Programme

United Nations Industrial Development Organization



United Nations Development Programme

CHEMICAL INDUSTRIES ADVISER

DP/INS/72/054

INDONESIA

Project findings and recommendations

Prepared for the Government of Indonesia
by the United Nations Industrial Development Organization,
executing agency for the United Nations Development Programme

Based on the work of Eric G. Hancock, chemical industries adviser

United Nations Industrial Development Organization
Vienna, 1975

Explanatory notes

Use of a hyphen (-) between dates representing years signifies the full period involved, including the beginning and end years, e.g. 1971-1973.

A slash (/) between dates representing years indicates a crop year or financial year, e.g. 1971/72.

Reference to "tons" indicates metric tons, unless otherwise stated.

Reference to "dollars" ($) indicates United States dollars, unless otherwise stated.

The term "billion" is used to signify a thousand million.

Details and percentages in tables do not necessarily add to totals, because of rounding.

The following abbreviations are used:

BHC	benzene hexachloride
CPM	Critical path method
DDT	dichlorodiphenyltrichloroethane
DDVP	dimethyldichlorovinyl phosphate
DMT	dimethyl terephthalate
LNG	liquified natural gas
MCPA	2-methyl - 4-chlorophenoxyacetic acid
MF	melamine-formaldehyde
MSMA	monosodium acid methanearsonate
PERT	Program Evaluation Review Technique
PVA	polyvinyl acetate
PVC	polyvinyl chloride
SBR	styrene butadiene rubber
TEL	tetraethyl lead
TSP	triple super phosphate
2,4-D	2,4-Dichlorophenoxyacetic acid
UF	urea-formaldehyde
VCM	vinyl chloride monomer

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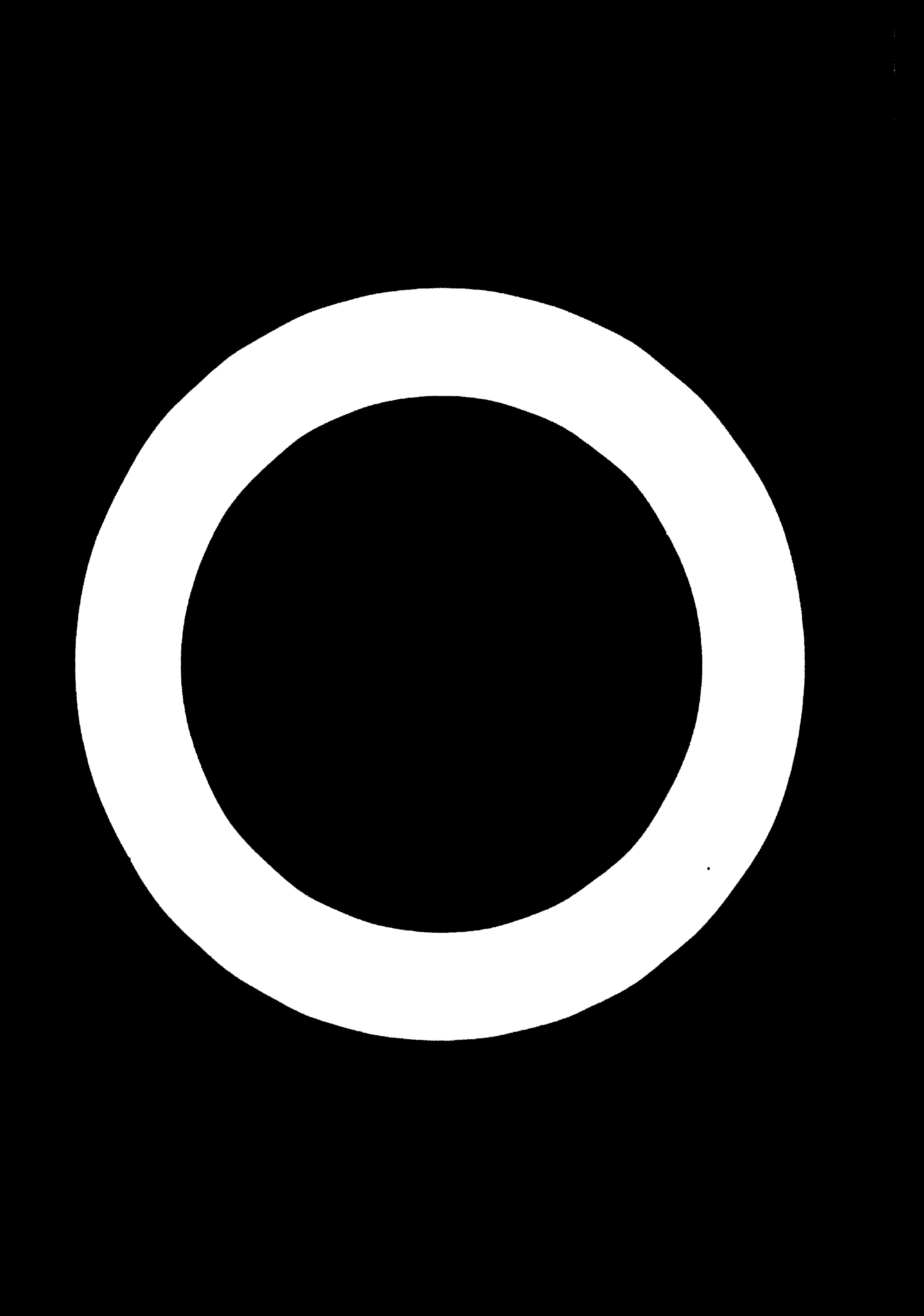

INTRODUCTION

The project

Indonesia's First National Five-Year Development Plan, 1969-1973 (Plan I) stressed the importance of developing the industrial sector. In particular, the chemical industry, which could utilize much of the country's raw material resources, was earmarked for expansion. The present document is the terminal report of a chemical industries adviser who was commissioned by the United Nations Industrial Development Organization (UNIDO), as executing agency for the United Nations Development Programme (UNDP), to assist the Government's Department of Industry, particularly the Directorate General of Chemical Industries, on policy and over-all planning matters related to the industry. Specifically, the expert, who was in Indonesia for one year, was to provide:

(a) Assistance in implementing the Second National Five-Year Development Plan, 1974-1979 (Plan II);

(b) Assistance in preparing perspective plans for the long-range development of the chemical industries;

(c) Guidelines for systematically collecting data from the industry and for analysing such data;

(d) Assistance in preparing sectoral studies and in evaluating studies carried out earlier;

(e) Assistance in drawing up terms of reference for major studies to be carried out by consulting firms;

(f) Guidelines for the practical application of modern methods in techno-economic feasibility studies and for the evaluation of such studies, using discounted cash flow analysis, linear programming, and network planning methods such as PERT, CPM etc.;

(g) Recommendations on the training of personnel for the industry.

The Directorate General of Chemical Industries

The work of the Directorate General, headed by a Director General, is divided into four main functions: secretarial administration, planning, implementation, and existing industries.

The Secretarial administration department deals with personnel, finance, security, internal office and investment/capital.

The Planning department, in addition to a secretariat, is divided into four products divisions dealing with fertilizers and petrochemicals; allied chemicals and tires; silicate industries; and cellulose industries.

The main functions of the Planning department are to produce long-term and medium-term development plans, to investigate new investment opportunities and to promote investment. Much of the time of the department is spent in analysing requests from foreign and local enterprises that wish to obtain licences for the production of products falling under the scope of the Directorate General. The department prepares long-term forecasts of the demand for their various products and carries out work concerning the various National Five-Year Plans. It takes part in specialized conferences, and the manager of the petrochemical division visits foreign countries to examine the latest techniques, particularly in fertililizers, and to discuss possible collaboration between the various countries of South-East Asia.

Representatives of the department regularly attend meetings of the Board of Investments so that proposals for new production units can be supported and followed up.

The Implementation department consists of a secretariat and three divisions with general responsibilities as follows: (a) a division which deals with facilitiss (largely financial), foreign investments, and contacts with other Directorates General, where activities in the implementation of the project concern them; (b) a division which deals with the progress of construction of the plant, with difficulties that arise and which helps clear equipment and parts through harbour and airports; and (c) a division which deals with start-up preparations, availability of raw materials, duty-free entry where necessary, and upgrading of labour.

The secretariat keeps records of the stage reached by each plant under construction.

The Existing industries department, in addition to a secretariat, has four divisions corresponding to the break-down under Planning, i.e.: fertilisers and petrochemicals; allied chemicals and tires; silicate industries; and cellulose industries.

This department deals with tax rebates, import duty, foreign competition, and effects of industry on the environment. Production and sales statistics are kept in great detail as a result of the practice of sending out questionnaires. The department acts as a focal point for resolving, or directing into the right channels, problems that arise in the operation of companies in the chemical industries field. The department tries to make regular visits to companies, particularly when they are in trouble.

The Director of the allied chemicals and tires division is also Secretary of the Joint Association of Companies under the Chemical Industries Directorate. The formation of associations in narrow fields has been encouraged and so far these have been set up in such sectors as paper, cement, other silicates, tires, gases, base chemicals, fertilizers and agrochemicals. Some of these specialist associations are still only at the formative stage. A preliminary meeting was held in August 1974 and all sections were asked to attend in order that any common problems might be reported to a Joint Meeting scheduled for February 1975. A meeting of the Joint Association with the Government had been fixed for March 1975. The membership subscription is modest and companies can join before they are in operation; in fact they may join as soon as they receive the Presidential decree authorising them to start constructing their plant.

The present organisation, with functional grouping at the directorate level, will be re-structured to product grouping at the directorate level and will comprise four product divisions: silicate industries, cellulose industries, allied chemicals and tires, and fertilizer and petrochemical industries.

The report

The report deals in considerable length with Plan II and, particularly in the petrochemical and base chemical industries, with arrangements for the Third National Five-Year Plan, 1980-1985 (Plan III). The action items in Plan II have been extracted from the Government's report (a free translation of which, as it affects the chemical industry, is given in annex I). Plans for implementation are next discussed, with criticism where appropriate. A list is given of all the companies operating within the Directorate General of the Chemical Industries together with those under construction and those at the planning stage. Proposals are made for the development of the petrochemical and basic chemical industries, including the setting up of Perum Petrokimia Gresik as an inorganic chemical centre and the development of an organic chemical centre in the neighbourhood of Palembang.

Statistics are next dealt with, including the present techniques used by the Central Bureau of Statistics. Some of the pitfalls in collecting statistics are discussed and the reason given why, in spite of the labour involved, it will be necessary for some years for the Directorate General to collect its own statistics. A model classification break-down for input and outputs drawn up in conjunction with the department concerned is given, together with a specimen form and notes relating to that part of statistics collection. Past surveys are summarized and commented on.

As the expert had been specially requested to firm up the Directorate's estimates for paper, cement and fertilizers, using macroeconomic techniques, this is discussed, and estimates for plastics are added. One chapter is devoted to recommendations for in-depth studies and what to do with them when completed. A chapter covers the technique of planning, including references to discounted cash flow, social benefit costing, the use of computers and the use of critical path diagrams.

Manpower and training in the chemical industry are dealt with in a short chapter and, finally, a summary is given of each of five lectures given to the staff in lieu of more specific counterpart training. These cover synthetic rubber; the effect of the oil price increase on the demand for plastics; discounted cash flow techniques; water and effluent treatment; and the production of chemicals from Indonesian minerals. Annexes IV and V contain a list of Indonesian chemical imports for 1973, and the current tariffs on these imports.

I. LONG-RANGE DEVELOPMENT OF THE CHEMICAL INDUSTRIES

Second National Five-Year Development Plan (1974-1979)

The highlights of Plan II, in so far as the chemical industry is concerned, are summarized below. A more detailed description will be found in annex I.

Paper

(a) Projects that feature the making of paper from bamboo and wood are to be implemented at Gowa (South Sulawesi) and Banyuwangi in East Java;

(b) Existing mills are to be rehabilitated; in particular, the paper mills at Padalarang and Leces will be expanded;

(c) Efforts will be concentrated on paper mills that use imported pulp but that make paper needed in Indonesia, such as writing paper, packaging paper, toilet paper and cardboard;

(d) The use of bagasse for a paper plant in East Java is being investigated.

If all these projects are successful, annual production will be:

	Thousands of tons
1974/75	47.3
1975/76	51.4
1976/77	42.7
1977/78	117.8
1978/79	201.2

However, even in 1978/79, production would be less than half the demand. These are not target figures, but estimates of production if existing and planned paper mills come on stream.

Allied chemicals and tires

(a) Salt production is to be improved both in quantity and quality;

(b) The development of the caustic soda industry is to be correlated with that of the petrochemical industry and the aluminium industry in Asahan;

(c) General development will be carried out of the base industries which supply the raw materials for the consuming industries and in order to substitute imports in quality as well as price;

(d) New capital investments in the motorcar tire industry are to be encouraged. Production is expected to rise from 1.55 million tires in 1974/75 to 2.65 million in 1978/79, representing 95 per cent of the demand in the second period.

Silicates

(a) Several cement plants that were planned and partly executed during Plan 1 are under construction;

(b) The Gresik cement plant is to be expanded to produce 1 million tons per year;

(c) A surplus of cement is expected by 1977/78, production rising to 5.5 million tons while demand will be only 4.4 million tons. This is a conservative estimate based on the low rate of growth in the past;

(d) As increased demand for glass bottles and plate glass is expected, increased production is planned. Production and demand of bottles are currently even and plate glass production will reach over 90 per cent of demand by 1976/77.

Fertilizers and petrochemicals

(a) Ammonia plants are planned to be on stream in West Java and East Kalimantan with capacities of 1,000 and 1,500 tons of ammonia per day respectively. Two thirds of the ammonia from the East Kalimantan plant will be used in urea production;

(b) It is planned to produce TSP at Gresik;

(c) It is intended to plan a petrochemical complex which will come on stream at the start of Plan III;

(d) A polyester industry for the production of synthetic fibres to be built with the aid of foreign capital on the understanding that the raw materials will for the time being be imported.

Should the projects outlined above come on stream successfully, and the additional 660 tons per day at the Pusri factory be realized, the total production of nitrogen at the end of Plan II is expected to be 657,000 t/a of nitrogen and 177,000 t/a of P_2O_5.

Strategy

At the mid-term tripartite meeting, the Director General requested comments on whether his strategy thus far was correct and asked for constructive suggestions for Plan III. The emphasis was to be on base chemicals, petrochemicals and fertilisers.

The situation in the petrochemical sector at that date was that Pertamina - a state-owned organisation - had decided to construct, with the technical aid of Commonwealth Oil, an aromatics complex at Pladju, just outside Palembang, South Sumatra. This would produce from naphtha (some of which would be imported) 400,000 t/a of benzene, of which 60,000 would be converted to cyclohexane to be shipped to Gresik where, together with excess ammonia from the plant in East

Kalimantan, it would be converted to caprolactam and ammonium sulphate. The aromatics complex would also produce 20,[illegible] t/a of orthoxylene and 120,[illegible] t/a of paraxylene. The former would be converted to dimethyl terephthalate or terephthalic acid, according to requirements. Construction of a phthalic anhydride plant with a 2[illegible] t/a capacity was envisaged for a later date.[1] A major part of the products would be exported but indigenous production of downstream products would naturally be encouraged.

At a previous meeting the expert had put forward plans for two ethylene complexes with the appropriate downstream plants, each of 200,000 t/a capacity and coming on stream in 1979 and 1984 respectively. They would be located at Tanjung, East Kalimantan (Pertamina Unit 4) and Rudan, North Sumatra (Pertamina Unit 1). The advantages of these sites were that the associated gas was very rich in C_2, C_3 and C_4, and these would make excellent cracking stock. Such a scheme had been in the Director General's mind in January when the petrochemical sector had first been discussed.

It now appeared that Pertamina, in conjunction with Mobil, was planning a petrochemical complex at the northern tip of Sumatra, near the town of Lhokseumawe in the Aceh area, using the C_2 fraction only of the non-associated gas from the Arun gas field operated by Mobil. Further, they were, against the expert's advice, in favour of constructing so-called "world-size" plants.

With fertilizers, the position was clearer. Pusri II was bought into operation during the year, making the combined output at Palembang 480,000 t/a urea. Construction of Pusri III has started and it will be on stream in 1977, producing a further 560,000 t/a of urea. The plant in North Bintang in East Kalimantan is due on stream in 1976/77 with a capacity of 525,000 t/a of ammonia, of which 350,000 will be converted to urea and most of the balance transferred to Gresik to be converted to caprolactam and ammonium sulphate. Meanwhile Pertamina is erecting a plant near Cirebon with a capacity of 560,000 t/a. Petrokimia, at Gresik, has a capacity of 45,000 t/a. For base chemicals, no major new plants were planned.

Primary needs

With regard to general strategy, the first priority for any country is food and housing for its people. Fertiliser production, without which

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1/ This was later revised by Pertamina to home-produced naphtha, 500,000 t/a of benzene; 62,500 t/a of hydrogenated to cyclohexane; 40,000 t/a of orthoxylene; and 300,000 t/a of paraxylene.

Indonesia's staple rice crop would be far from adequate, therefore carries a very high priority and the aim to make Indonesia self-sufficient in N fertilizer by the end of the current Five-Year Plan period is sound. Urea, a fertilizer that supplies nitrogen under water, is ideal. And, as urea is a very concentrated form of nitrogen, it is less costly to transport. With natural gas in relatively free supply, the correct strategy for the chemical industry is clearly to concentrate first on the production of urea fertiliser.

Besides N, P_2O_5 is required for many crops. Again, this should be in the most concentrated form possible and it is a choice between triple super (P_2O_5 content 45 per cent) or one of the ammonium phosphates(usually something between mono- and di- is produced giving a P_2O_5 content of 55 per cent). The decision to carry out a feasibility study and design engineering (by Chemico) is therefore the correct strategy and, in view of the facilittes already available, Gresik is the natural centre for these activities.

While straight fertilizers have long been the preferred source of nutrients, there is a growing call for compounds. The most favoured compound is 15-15-15 and this can be produced, for example, by blending 24 per cent chloride of potash, 27 per cent diammonium phosphate and 49 per cent ammonium sulphate. This means that Gresik will also be a natural centre for compound and it is correct stragegy to include this in Chemico's feasibility study.

The sise of the plant needs further thought. Only 300,000 t/a of phosphate and compound fertilisers are planned while the demand in 1978 is expected to be over 800,000 tons.

In conjunction with fertilisers, the use of the correct pesticide is essntial to obtain the best results. Pesticides are not mentioned in Plan II but their importance has perhaps been underestimated. Many pesticides are complex chemicals which may have to be imported at least in semi-finished state for some years; nevertheless, it is strongly recommended that more attention be given to this area.

With regard to housing, while many vegetable products are used in low-cost housing, the trend is to use more long-lasting products, particularly concrete. In any national housing drive, ample supplies of home-produced cement are essential. It is obviously sound policy to place emphasis on increasing production capacity in this area. An important factor here is the high transport factory cost ratio and hence the importance of having production strategically located. If present plans for cement production are followed through, production will exceed consumption by the end of the current Five-Year Plan period. No further cement projects need be authorized for three or four years, and then great emphasis should be placed on location to prevent wasteful competition.

The next point to consider is whether Indonesia is making the best use of its raw materials. First, consideration must be given to oil and natural gas, which are the potential sources of both fertilizers and petrochemicals. Overall development has been entrusted to Pertamina and the production of petrochemicals and more fertilizers has to await its decision as to what raw materials will be available. The concern at present is to use the oil products to best advantage in Indonesia as a whole; much will be exported to earn foreign exchange while some will be required as fuel. In so far as a decision was taken to develop a petrochemical centre during Plan II, the strategy was perfectly correct as the information necessary to be more precise was not available at the time. The surveys that have been commissioned by Japanese Gasoline Co. and by Unico have been of less value than they might have been due to lack of basic information. Unico is revising its survey in the light of the latest decision to base the complex on Arun ethane.

Secondly, consideration must be given to mineral products. The production of cement and glass has already been mentioned. Indonesia is rich in a number of other minerals that could well form a basis for chemical production instead of exporting the ores and leaving other companies to produce the chemicals.

Thirdly, the replacement of imports by home production wherever this can be carried out in a viable plant is certainly a correct strategy and great care has been taken in this report to obtain the latest import figures and to comment where production is likely to prove viable.

The background for chemical development

Indonesia is basically a free economy. Except for products such as tires, fertilisers, cement, salt and paper, the Government, through the Directorate General of Chemical Industries, does not own the equity of any production in the chemical field and according to present plans does not intend to expand its direct involvement. Rather, it will seek to encourage the development of private investment. It is seldom that the technology or finance for a new chemical enterprise or for the modernization of an existing one is available in Indonesia and that no foreign know-how or investment is needed.

It should be pointed out that as there is no patent law in Indonesia foreign companies are reluctant to release potential know-how without some degree of control. The development of a patent law should therefore be a high priority for the Indonesian Government. The Government is anxious, however, not to let the control of industry pass into foreign hands and in this way foreign investment is restricted. The regulations change frequently, but are not made retroactive. For example, companies that are completely foreign-owned but established under earlier regulations can continue in operation.

The latest regulation is that foreign companies must have an Indonesian partner. The foreign company can start with as high a proportion of the shares as it wishes, but the national holding must be increased as rapidly as possible until it reaches 51 per cent. The exact timing for this is not specified and depends on the type of operation and the capital involved.

New foreign investment is certain types of chemical production is not allowed at all. The list is under review by the Investment Board but is understood to include sheet glass and glass bottles; oxygen, carbon dioxide, acetylene and other gases; calcium carbide; aluminium sulphate; and, rather surprisingly, polyvinyl acetate and PVC.

The mechanics of dealing with a potential new foreign investor is that he makes his application in a letter of intent to the Investment Board, which passes it to the appropriate ministry, which then passes it to the Directorate General concerned. The Investment Board comprises representatives of many industrial sectors. Among its duties it considers whether tax holidays should be granted, whether roads, and water and electricity supplies are adequate, and whether new housing is required.

It will be appreciated from what has been said that when in the course of this report it is recommended that a certain chemical should be produced, it is not to be expected that the Directorate General of Chemical Industries can take any action unless it receives an application from a party interested in producing the chemical, when the previous recommendation will no doubt be noted.

This is an unsatisfactory state of affairs as it means that isolated chemical production starts up all over the country with little or no interconnexion and only in the vaguest way as the result of any planning.

A major difficulty arises from the fact that many of the major users of chemicals are outside the field covered by the chemical industry and only limited contact is maintained. These include manufacturers of soap and detergents, cosmetic and pharmaceutical products, synthetic fibres and textiles, and paints; the plastics processing and electrical industries (cables) and, to a lesser extent, many others.

The first recommendation is that an informal body be set up by the Directorates General concerned to provide a two-way flow of information between users and producers of chemicals.

A suggestion was made by the Directorate General that such a body be formed for petrochemicals, but this recommendation is intended to cover a much wider field. The Directorates General of Chemical Industries, Light Industries, Basic Industries, Textile Industries, Pharmaceutical Industries, and Oil and Gas Industries, together with Pertamina and Bappenas should be represented. The Ministry of Agriculture should also be requested to send representatives to cover fertilisers and pesticides.

The terms of reference should be:

(a) To collect precise information on the raw materials available;

(b) To investigate all applications for joint ventures and to examine the market forecasts;

(c) To keep up-to-date records of the current and estimated demands for all types of chemicals and chemical products;

(d) To initiate special studies in the use of chemicals, where necessary;

(e) To sponsor the formation of trade associations, which would, in addition to the usual function of a trade association, explore the possibility of exporting downstream products;

(f) To set up centres where information would be available and where research, training and testing could be carried out for particular downstream industries such as plastics, paints, fertilisers or pesticides.

The second recommendation is that an organisation be set up to persuade chemical companies all over the world of the opportunities and advantages of investing in Indonesia. This could take the form of a bulletin, issued perhaps on a quarterly basis, which would be sent by post to all the major chemical companies in the world not represented in Indonesia. It would also be circulated to companies already represented or engaged in production in Indonesia as there might be opportunities for them in fields not covered by their existing activities. It should also be made known that this organization would answer questions promptly about facilities for investment, would assist representatives visiting Indonesia in making the proper contacts, and would maintain a list of Indonesian companies or investors prepared to consider contacts with foreign companies for the production of chemicals.

The third recommendation is, as mentioned above, that pressure be exerted on the appropriate organs in the Government to introduce a patent law.

Long-term development of the petrochemical and fertilizer industry

Petrochemicals are often divided into two groups: specification chemicals, such as vinyl chloride, benzene, cyclohexane, styrene and p-xylene; and performance chemicals, such as polyethylene, PVC, polystyrene, and most resins and high polymers.

Specification products can be laboratory-tested and, if they pass the test, can compete in world markets. A specification product not up to standard can frequently be reworked (e.g. redistilled) to enable it to pass the test.

Performance products, while a good idea of their suitability can be obtained in laboratory tests, can only be finally confirmed as suitable after testing for the actual application for which they are intended. Further, they cannot be refined to correct any deficiencies once they are produced.

Provided that the product is produced from Indonesian oil or gas, it is reasonable to produce specification products for the world market. Even if overproduction does take place temporarily, it will always be possible to sell the Indonesian product at a nominal profit as the price at which the raw materials, oil or gas, can be charged into the process can be decided locally. Indonesia will always be in a position to undersell products made in a country where the raw material has to be imported at the full price.

While to some extent the same applies to performance products, the costs of production are normally more dependent on factors other than the price of crude oil, and buyers are more use-quality conscious. As there will be little opportunity to compete in the world market in periods of overproduction, production should be oriented to the home market. Only if long-term supply agreements can be arranged with neighbouring countries, should any export market be relied on. Table 1 shows the petrochemical and fertilizer plants currently operating, under construction, or planned in Indonesia.

Table 1. Petrochemical and fertilizer plants

Name and location	Product	Capacity (t/a)
<u>Petrochemical plants in operation</u>		
Pertamina (Plaju)	Polypropylene	20,000
P. T. Dumaco (Bandung)	UF resin	2,400
Pertamina (North Sumatra)	Carbon black	2,000
<u>Petrochemical plants under construction</u>		
Pertamina (Plaju)	Benzene	500,000
	Ortho xylene	40,000
	Para xylene	300,000
	Cyclohexane	62,500
P. T. Eastern Polymers (construction completed, but not in operation)	PVC	20,000
P. T. Standard Polymer (Merak)	PVC	24,000
P. T. Pulosynthetic (Jakarta)	PVA	2,400
<u>Petrochemical plants planned</u>		
Pertamina (Lhokseumawe, North Sumatra)	Ethylene	450,000
P. T. Indonesia Polychemical Industrial Corp. (West Java)	Polystyrene	14,000
Petrokimia (Gresik)	Caprolactam	60,000
P. T. Kalhold (plus C. Itoh and Co. and Nippon Zeon Ltd.) (Cilacap)	PVC	12,000
P. T. Palapa	UF and MF adhesives	18,000
Rohm and Haas	Formaldehyde	12,000
	Hardeners and fillers	480
P. T. Sarana Surat Kimia (Plaju)	Acrylic and methacrylic Polymers	4,000
	p-xylene	100,000
	DMT	150,000
Pertamina	Carbon black (discussion with Philips and Asai at an early stage)	100,000

Table 1. (continued)

Name and location	Product	Capacity (t/a)
<u>Fertiliser plants in operation</u>		
Pusri I (Palembang)	Urea	100,000
Pusri II (Palembang)	Urea	380,000
Petrokimia (Gresik)	Ammonium sulphate	120,000
	Urea	45,000
<u>Fertilizer plants under construction</u>		
Pusri III (Palembang)	Urea	560,000
________ (North Bintang, East Kalimantan)	Urea	
	Ammonia (not converted to urea)	175,000
Pertamina (Cirebon)	Urea	560,000
<u>Fertilizer plants planned</u>		
Petrokimia (Gresik)	TSP and/or di-ammonium phosphate and compound fertilizers	400,000

<u>Aromatics complex</u>

The planned aromatics complex is almost certainly sound as regards benzene and fairly sound as regards p-xylene, the difference being that benzene has a multitude of uses and p-xylene only one of any importance (polyester fibres). Expansion in this area during the Third National Five-Year Plan would not seem viable and it is therefore recommended that:

(a) The cyclohexane market be explored and, if appropriate, the cyclohexane plant expanded. (Many nylon producers prefer to start with cyclohexane rather than benzene);

(b) Sufficient flexibility be introduced to enable toluene to be produced if there appears to be a market, particularly a local one. (Toluene is required in the production of polyurethane foam and explosives and has numerous small uses in fine chemical manufacture.)

With regard to downstream products, phenol, nitrobenzene and aniline will be needed in Indonesia if an organic chemical industry of any size is ever to develop; and all of these products are derived from benzene.

Anthraquinone dyes are made basically from benzene and phthalic anhydride, both of which will be available under the current plans, and studies should be made of the potential market. A very rough survey has indicated that a substantial proportion of the dyestuffs now used in Indonesia are anthraquinone-based and that if all the appropriate dyestuffs were made in Indonesia, a market for about 2,500 tons of anthraquinone and its derivatives would exist.

It has already been decided to make caprolactam from cyclohexane at Gresik; however, thought should be given to reversing this decision and to make the caprolactam instead in East Kalimantan, near the ammonia plant. This would avoid the need for any tranJfer of ammonia and would be of social benefit to the area. To avoid duplication of technicians and laboratory services, it is strongly recommended that Gresik be kept an inorganic centre. Further, the more conventional route to caprolactam via cyclohexanol cyclohexanone should be used rather than the Toray photochemical process, partly because of the power savings and also because the techniques are more established.

Organic chemical centre

It is recommended that a centre be established for downstream organic chemicals, preferably not too far from Palembang where supplies of benzene, xylene and possibly toluene would be within easy access. All companies interested in developing themselves in this field should be encouraged to use the centre where facilities, electricity, fuel, roads, water and good communication could be made available at a moderate cost. It is recommended that the site be chosen now and a start made with the necessary infrastructure, even if actual production does not commence until well into Plan III. All companies using aromtaics as raw materials or making downstream products from products (imported in the early stages) that are themselves made from aromatic compounds should be invited to use this centre, provided their output is not likely to exceed 20,000 tons per year. Other organic chemical manufacturers would also be welcome.

The establishment of such a centre offers a number of advantages:

(a) Training courses could be organised, which would enable chemical operatives and junior technicians from all the chemical industries on the site to be trained;

(b) Joint facilities, e.g. engineering workshops, water conditioning, effluent disposal control and possibly even joint testing laboratories, could be set up. Possibly also a joint reference library would increase the efficiency of the whole complex while technical staff associated with small units would not feel so isolated. The whole infrastructure could be shared.

Industries associated with such a centre would include detergents; dyestuffs; all types of intermediates, e.g. for pesticides, paints, dyestuffs themselves and also water treatment chemicals; plastics additives; and plasticizers - but mainly those based on aromatic hydrocarbons. The production of diazanon, now planned for Gresik, might well be transferred to such a site.

Ethylene complex

Plans for the ethylene complex in the Aceh district are vague at present. It appears that propylene will be available only in very small quantities and the main products will have to be derived from ethylene. This means polyethylene (high and low density), vinyl chloride, ethylene oxide and its derivatives and possibly styrene. The latter is made from benzene and ethylene, but requires three times the weight of the former. It is questionable whether it would be cheaper to bring the benzene to the ethylene or the ethylene to the benzene. Transportation figures received from Esso are: $19 to $20 per ton for benzene and $30 to $40 per ton for ethylene, for 1,000 miles. On the basis of these figures it would clearly be cheaper to bring the ethylene to the benzene and to establish a styrene plant near Plaju. On the other hand, Dow is very interested in downstream plants on the Aceh site and Dow officials have stated that if they go ahead, they would want all their operation to be together for ease of control.

In the absence of propylene, the production of butyl alcohols and 2-ethyl hexanol (for plasticizer production) should be considered via the aldol condensation of acetaldehyde produced by the oxidation of ethylene via the Wacker process. In this case the acetaldehyde should be produced at the Aceh site and the acetaldehyde transported to a site closer to manufacturing centres for working-up, e.g. at the organic chemicals centre near Palembang.

Ethylene glycol will be required for polyester fibre production. If ethylene were to be brought to Plaju for styrene production, it would be sensible to construct an ethylene oxide/glycol plant in the same area as it would be particularly handy for p-xylene production. It would scarcely be worthwhile, however, to bring ethylene for this project alone; it would probably be preferable to make the ethylene glycol at Aceh and transport this product to wherever it is needed - and this would really depend on where it was proposed to produce polyesters.

Natural gas surplus

There is another point that should be touched on here. Owing to the location, and the lack of local use, great quantities of associated gas are being flared. The quantities given for 1973 are in table 2.

Table 2. Flaring of associated gas, 1973

Location	Company	Flared gas (ft^3)
Prabumulih, South Sumatra	Pertamina II	$15,000 \times 10^6$
Tanjung, East Kalimantan	Pertamina IV	$11,000 \times 10^6$
Minas, Pematang Duri, Central Sumatra	Caltex	$19,000 \times 10^6$
Radja, South Sumatra Lirik, Central Sumatra	Stanvac	$28,000 \times 10^6$
North Sumatra	Asmara	$10,000 \times 10^6$
East Kalimantan	Union Oil	$18,000 \times 10^6$

As an ammonia plant with a 330,000 t/a capacity requires $13,000 \times 10^6$ ft^3 per year, it is clear that the raw material for some six such ammonia plants is available literally for nothing. It is appreciated that the infrastructure in the neighbourhood and the enormous capital expenditure needed prohibits such construction at the present time, particularly as it is forecast that present plans will produce more than Indonesia's requirements of fertilizer by the end of Plan II. The scope for devolopment in Plan III is obvious, however. It is understood that plans are under discussion for the construction of two new plants, one in the Aceh district and the other in East Kalimantan, each with a capacity of 330,000 t/a of ammonia to be converted to urea. It is recommended that methyl alcohol be produced from some of these gas flares and used:

(a) As a fuel which, transported over long distances, can be competetive (this is particularly the case since the raw material at present costs nothing);

(b) As a chemical to manufacture formaldehyde and, if necessary DMT;

(c) As a solvent (a minor use);

(d) As a constituent of motor gasoline, say 10 per cent. Methanol has a high anti-knock value and would enable the use of tetraethyl lead to be reduced or eliminated.

As it boils at 65°C and forms with many hydrocarbons constant boiling mixtures that boil at even lower temperatures, its addition to gasoline would enable the volatile C_4 and C_5 compounds in the gasoline to be reduced without affecting ease of starting.

The high latent heat of methanol, as compared with hydrocarbons, tends to keep the engine cool. One of the reasons for rejecting it in the 1930s after comprehensive tests in the United Kingdom was that with the design of carburettor popular at that time, the engine took too long to warm up on cold days: this would hardly apply in Indonesia. The other major disadvantage shown in the tests was that when blended with a straight gasoline, common in those days, the addition of aromatics was essential to maintain a homogeneous liquid. Further, accidental contact with appreciable quantities of water led to the separation of the motor spirit into two layers.

A modern gasoline, however, containing cracked and/or reformed products would easily tolerate 10 per cent methanol, and the higher temperatures in Indonesia would substantially increase the solubility tolerance.

Since methanol is more expensive than gasoline, there has never been major inducement for replacement in the industrialised countries, but with the special conditions that apply in Indonesia, further examination, in depth, is recommended.

<u>Future of Perum Petrokimia at Gresik</u>

Perum Petrokimia is a petrochemical works and will remain so as far as the production of ammonia and urea are concerned, but its activities will spill over into the field of base chemicals. It is therefore recommended that:

(a) The plant be developed for inorganic chemicals only, and plans for making caprolactam and diasanon should be abandoned. This would have the tremendous advantage of concentrating the skills required, the specialists in inorganic chemistry, the laboratory equipment, the specialist libraries etc. It would mean that the Director would be able to familiarise himself in some detail with all the processes. Marketing and marketing records would be simplified, i.e. there would be a general reduction in the overheads for running the plant, and it could be the centre at which all further inorganic developments, except those directly connected with petrochemicals, should take place;

(b) The following products be produced in the near future: ammonia, soda ash, urea, sulphuric acid, triple super phosphate, sodium tripolyphosphate, compound fertiliser, carbon dioxide, nitric acid, and possibly caustic soda-chlorine;

(c) Production should be as follows:

(i) Rock phosphate should be treated with sulphuric acid to give phosphoric acid and gypsum;

(ii) Gypsum should be reacted with ammonia and carbon dioxide to give ammonium sulphate (thus, no sulphuric acid needed);

(iii) Phosphoric acid should be reacted with more phosphate rock to give triple super phosphate; and soda ash to give sodium tripolyphosphate as a builder for detergent;

(iv) Soda ash should be produced from salt, ammonia and carbon dioxide by the ammonia soda process. The dual process in which ammonium chloride would be produced should be studied; ammonium chloride has been stated to be an excellent fertilizer for paddy, but it has also been stated to be not suitable for Indonesian soil. It is claimed that the modified process is viable at lower capacities than is the original ammonia soda process;

(v) Nitric acid on a small scale, e.g. 5, [illegible] could be produced by the oxidation of ammonia. This would be available for general industrial use or, until the demand [illegible], for the production of ammonium nitrate as a fertilizer or an explosive;

(vi) Provided reasonable demands for chlorine, e.g. in paper production, textile bleaching, water conditioning, herbicide and insecticide production, show signs of developing, a 30,000 t/a plant based on Madura salt would be justified. It now appears that the chlorine caustic soda plant for VCM is likely to be in the extreme north of Sumatra and it will not be economical to transfer chlorine to all the small consuming plants in the more industrially developed parts of Indonesia;

(vii) The production of caprolactam should be transferred to East Kalimantan where ample ammonia is available;

(viii) The production/formulation of diazanon should be transferred to the proposed organic chemicals site near Palembang.

Long-term development of allied chemicals and tires

Tires

Table 3 shows the current situation with regard to tire and tube production in Indonesia.

The only comment here is whether the production of any compounding ingredient is needed. Synthetic rubber was discussed with the management of the tire industry and it is clear that in the foreseeable future there will be no scope.

Carbon black and zinc oxide are the most likely compounding ingredients; carbon black is already produced by Pertamina and a further plant is planned.

The production of zinc oxide has passed the planning stage and P.T. Indo Lysaght has the production in hand but is having difficulty in obtaining land.

Table 3. Tire and tube production

Name and location	Product	Capacity (per year)
Plants in operation		
P.T. Intirub (Jakarta)	Car tires	195,000
	Car inner tubes	195,000
	Bicycle tires	10,000,000
Perum Ban and Karet Palembang (Palembang)	Car outer tires	180,000
	Car inner tubes	51,900
P.T. Goodyear Tire and Rubber Co. Ltd (Bogor)	Car inner tubes	540,000
	Truck and bus tires	343,000
	Tires for bicycles, motor scooters and becak	3,780,000
	Inner tubes for bicycles	690,000
P.T. Gajah Tunggal (Jakarta)	Bicycle/scooter tires	120,000
Plants under construction		
P.T. Bridgestone Tire Indonesia (Jakarta)	Tires for cars (1st stage)	460,000
	Tires for cars (2nd stage)	856,000
P.T. Naga Rubber (Semarang)	Bicycle/scooter tires	180,000
P.T. Nito Rubber (Jakarta)	Bicycle/scooter tires	180,000
P.T. United Kingland (Tangerang)	Bicycle/scooter tires	420,000
P.T. ABS Rubber Works (Medan)	Bicycle/scooter tires	180,000
Extension to P.T. Goodyear Tire and Rubber Co.		
Plants planned		
P.T. Induban Naga Mas	Car tires	648,000

Note: Bicycle tires are the responsibility of the Directorate General of Light Industries and Handicrafts.

Pesticides

Table 4 shows the current situation with regard to pesticide production in Indonesia.

Apart from formulation, the most interesting possibilities for production are DDT or malathion; diazinon; and herbicides based on phenoxyacetic acids.

About 4,000 t/a of DDT are expected to be needed during the next four or five years for malaria control. Malathion would be preferred, but the cost is at present prohibitive. Production in Indonesia should be studied.

Table 4. Pesticide production

Name and location	Product	Capacity
<u>Plants in operation</u>		
P.T. Bayer Agrochemical (near Jakarta)	Antracol, Baygon, Dipterex, Develop, Bayrusil, Tamaron, Lebaycid (later Ustinex and Tribunil)	300 t/a liquid 500 t/a solid (to be doubled in 1975)
P.T. I C I Agriculture Indonesia (Cimanggis)	Agroxone Gramoxone (later Paracol, Fenitrothran and MCPA)	1.2 million litres 1.2 million litres
Pertamina (near Jakarta)	Insecticides	1.0 million litres
Pertamina (Medan, North Sumatra)	Herbicides	0.7 million litres
<u>Plants under construction</u>		
P.T. Bona Spes (Medan, North Sumatra)		
P.T. Pacific Chemicals-Dow (Medan, North Sumatra)	Dalapon	3,600 t/a
<u>Plants planned</u>		
P.T. Deutsche Hamburg (Jakarta)	Malathion DDVP Fenitroltrion Carbaryl Diazinon Zineb Maneb	1,000 t/a liquid
P.T. Malatham (Jakarta)	Phosvel DDVP Diphacin	250 t/a
P.T. Bhirawa	Diazinon	

Table 4 (continued)

Location and name	Product	Capacity
P.T. Indagro (Jakarta)	DDT	3,600 t/a powder
	Carbaryl	11,000 t/a granules
	Carbofuran	
	Diazinon	4,400 t/a liquid
	Malathion	
	Fenthion	
	Dimethoate	
	Copper oxy chloride	
	Diuron	
	2 4 D	
	M S M A	
Perum Petrokimia (Gresik)	Diazinon	27,000 t/a liquid 7,000 t/a granules
Ciba - Geigy (near Jakarta) (realization doubtful)	Diazinon	
P.T. Agrocarb - Union Carbide (Surabaya)	Sevin Temik	7,000 t/a

Diazinon is an excellent general-purpose insecticide and considered non-toxic. It is planned to make this at Gresik, but it is recommended that its production be transferred to the proposed organic chemicals site near Palembang.

This would also be an excellent site for phenoxyacetic acids.

The outline routes and chemicals required are:

(a) DDT, produced by reacting chloral with chlorobenzene in the presence of oleum;

(b) Malathion and diazanon, both needing phosphorus pentasulphide which is dangerous and highly inflammable; not suitable for manufacture here or importation. For diazanon the sulphide is partly chlorinated before reacting with ethyl alcohol; for malathion the methyl ester is produced. Diazanon needs further highly complex chemicals, but malathion is produced by reacting the dimethyl thiophosphate with diethyl maleate, which with ethyl alcohol and benzene as raw materials could readily be made here;

(c) Phenoxyacetic acids, produced by sodium phenolate with monochlor acetic acid, the phenol being substituted with chlorine and/or methyl groups depending on the product desired. The acid is always used after neutralization.

<u>Caustic soda-chlorine</u>

Table 5 shows the current situation with regard to caustic soda-chlorine production in Indonesia.

Table 5. Caustic soda-chlorine production

Name and location	Product	Capacity (t/a)
Plants in operation		
P.N. Garam (Madura)	Salt	300,000 (but varies according to season)
P.N. Soda Waru (Waru)	Caustic soda Chlorine	3,000 2,700
Plants under construction		
Extension to P.N. Soda Waru (Waru)	Caustic soda Chlorine	6,000 5,400
Modernization of P.N. Garam (Madura)	Salt	280,000
Plants planned		
P.T. Jatim Utara Steel (Surabaya)	Caustic soda Hydrochloric acid	8,000 (solution 32 per cent) 7,000 (solution 32 per cent)
P.T. Rejeki Lancar (Bandung)	Caustic soda Hydrogen chloride (especially for the textile industry) Caustic soda	6,000 5,000 1,200 (98 per cent)
P.T. U [illegible] Jaya	Bleaching powder	600 (60 per cent chlorine)
Toyo Engineering (realisation doubtful)	Soda ash and part causticisation to caustic soda	80,000 soda ash (part converted to 32,000 caustic soda)

Any long-term plan is complicated at the moment by a large number of uncertainties.

The first is the Asahan Dam project and the aluminium smelter to be linked with it. The Asahan Dam project envisages the damming of the Asahan river in North Sumatra and the erection of the major power plant, which would be used essentially for aluminium smelting. Bauxite from Kalimantan and other sources would be refined to alumina, for which a substantial weight of caustic soda, [illegible] to [illegible] t/a, would be required. The cost of electricity for a caustic soda-chlorine plant generated by water power would be, according to Dow, little more than one tenth that of electricity generated from a convertional oil-burning power plant based on the current price of fuel.

It would therefore seem ideal to associate a caustic soda-chlorine plant with the Asahan aluminium project, the caustic soda going mainly for bauxite refining and the chlorine for vinyl chloride. This does not entirely solve the problem of whether to take the chlorine to the ethylene or the ethylene to the chlorine, which would need further study.

At the time of writing, however, it appears that agreement with the Japanese consortium that had been negotiating with the Government has not been completed. One suggestion has been to treat the dam quite separately from the aluminium plant. If no agreement is reached on the dam, the Government has stated that it will seek aid elsewhere.

Dow feels the position is too uncertain to be relied on, and doubts whether there would be sufficient power from the plant to produce chlorine on the scale envisaged. Further, if Dow decides to go ahead with downstream products from an ethylene centre, it would prefer this to be on one site.

Salt, the raw material, is an important factor. Only on Madura Island is it being produced under controlled conditions, but this means a very long haul. It is said that the climate is not suitable for salt to be produced by solar evaporation elsewhere, but this is not an altogether convincing argument: some of the Eastern Islands, which have very low rain-fall, should be considered. In any case, this would not help a chlorine-caustic soda plant in Asahan or Aceh. Dow is apparently prospecting for brine in North Sumatra and hopes this will prove to be the source of the salt needed. Further, under current plans, P.T. Garam in Madura will not be able to produce sufficient salt for a plant on the scale Dow is envisaging, i.e. well over 100,000 t/a.

P.N. Soda Waru expects to produce over 5,000 t/a of chlorime by 1976; two companies are planning to make together 12,000 t/a of 32 per cent hydrochloric acid, while a third is planning a small quantity of bleaching powder. Chlorine is required for a wide range of industries, particularly paper, textiles and pesticides. On balance, therefore, it is recommended that Perum Petrokimia plan to produce 30,000 t/a of chlorime (35,000 t/a of caustic soda) using some

70,000 t/a of salt from P.N. Garam. No steps will be taken to implement this until a final decision is made to erect a caustic soda-chlorine plant in North Sumatra, either on the Asahan river or in Aceh. The chlorine from such a plant would be exclusively or almost exclusively used for VCM, while a substantial demand for chlorine would arise in the more industrialized parts of Indonesia.

Miscellaneous chemical plants

Table 6 gives a break-down of miscellaneous chemical plants in operation, under construction, or planned in Indonesia.

Table 6. Miscellaneous chemicals plants

Name and location	Product	Capacity (t/a)
Plants in operation		
P.T. Indonesia Acid Industries Ltd (Jakarta)	Sulphuric acid	5,500
P.T. Mahkota Industri Kimis (Jakarta)	Sulphuric acid	20,000
	Aluminium sulphate	30,000
P.T. Victory Water Glass (Jakarta)	Water glass	12,000
P.T. Dumaco (Bandung)	UF resins and desizing agents	9,000
P.T. Padahardja (Tegal)	Ethyl alcohol	600
P.N. Madu Kismo (Yogyakarta)	Ethyl alcohol	3,200
P.N. Pinda Assen (Mojokerto)	Ethyl alcohol	2,400
P.N. Comal (Comal)	Ethyl alcohol	1,600
State-owned company (Palamanan)	Ethyl alcohol	1,600
Plants under construction		
P.T. Hanindo (Padalarang)	Calcium carbide	12,000
P.T. Indo Lysaght	Zinc oxide	2,500
P.T. Industrial Acid Indonesia (Jakarta)	Sulphuric acid	15,500
	Aluminium sulphate	8,600
	Potassium sulphate	1,500

Table [illegible] (continued)

[illegible]	Product	Capacity (t/a)
Plants planned		
. . Nikka [illegible] (Jakarta	Surface active agents	2,4[illegible]
. . [illegible]wer [illegible] Indus. (Jakarta)	Ethyl alcohol	12,[illegible]
. . [illegible] Industries [illegible], Ltd [illegible]	Sodium sulphate and hydrochloric acid	9
. . [illegible]	Alkyl benzene sulphonate (will later make alkyl benzene)	3[illegible],
[illegible] ([illegible] and [illegible]kanta - [illegible] interested)	Alkyl benzene and derivatives	2[illegible],
. . Asen [illegible]	Ethyl alcohol	8,000
Name not selected yet (. . [illegible] and Dharma [illegible]mishi Showa Chemicals are interested)	Calcium citrate from tapioca waste	3,000
. . [illegible]	Calcium citrate and citric acid from tapioca waste	3,6[illegible] (stage 1) 6,[illegible] (stage 2) 12,[illegible] (stage 3) About one third of the calcium citrate will be converted to citric acid
[illegible] (Tasikmalaya)	Explosives (e.g. nitroglycerine)	Not known

These [illegible] are developing somewhat haphazardly with little or no connexion with other chemical institutions. The raw material or semi-finished product is imported. The import figures for 1973 indicate that there is scope for the production of certain products:

(a) Formic acid (or sodium formate). This is produced from caustic soda and carbon monoxide. Some 4,500 tons were imported in 1973 at a cost of $1.[illegible] million;

(b) Carboxylic acids (other than formic acid). In 1973, 18,000 tons, valued at $6 million, were imported. A market survey should be carried out to find out which are of interest and, subsequently, a feasibility study on any that seem worth producing;

(c) Activated carbon. 6,000 tons, valued over $1 million, were imported in 1973. A survey to find the long-term market should be carried out, followed by a feasibility study;

(d) Disinfectants (other than coal raw products). These may come partly under the Directorate General of Pharmaceutical Industries, but 9,321 tons valued at over $10 million were imported. A market survey and feasibility study are recommended;

(e) Sodium tripolyphosphate. About 7,000 tons were imported in 1973, but demand will soar when the companies planning sulphonated alkyl benzene commence marketing their products or formulating detergents. Production is recommended in a comprehensive plan for Perum Petrokimia, but if this recommendation is not accepted, sodium tripolyphosphate should still be treated as a separate case and a feasibility study carried out.

The other major area of development is in the production of chemicals from indigenous mineral ores; much of such production could be exported. Indonesia is already exporting the minerals and a study on the upgrading of these to finished products could lead to some profitable chemical developments. One use of special interest would be the production of catalysts. This would have to be done under licence from some catalyst manufacturer (e.g. ICI catalyst), but it would not only allow the better exploitation of local minerals, it would result in the manufacture of valuable products which, in view of their relatively light weight, could be exported all over the world. There would be a substantial local demand in the oil refining and petrochemical industries.

A second possibility would be the manufacture of organic metallic plastic additives (discussed later in greater detail).

Gases

Table 7 shows the current situation with regard to the production of gas in Indonesia. It is understood that further investment in this field is not being encouraged and that foreign participation is excluded.

Silicate industries

The current situation with regard to the cement and glass sectors is shown in tables 8 and 9.

Table 7. Gas production

Name and location	Product	Capacity (per year)
Plants in operation		
P.T. Aneka Gas Industri (Jakarta)	Oxygen	4,[illegible]00,000 m^3
	Carbon dioxide	300 tons
	Oxygen	1,000,000 m^3
	Dissolved acetylene	160 tons
	Carbon dioxide	2,700,000 m^3
P.T. Pan Nusantara (Jakarta)	Oxygen	216,000 m^3
P.T. Oxygen Indonesia Oxindo (Palembang)	Oxygen	216,000 m^3
P.T. Nila Alam (Palembang)	Oxygen	216,000 m^3
Plants under construction		
P.T. Nila Alam (Surabaya)	Oxygen Surabaya	432,000 m^3
P.T. Nila Alam (Palembang)	Oxygen	216,000 m^3
P.T. Nila Alam (Jakarta)	Oxygen	1,116,000 m^3
P.T. Medan Oxygen Industri (Medan)	Oxygen	288,000 m^3
P.T. Sumatera Gas (Medan)	Oxygen	288,000 m^3
P.T. Nila Alam (Jakarta)	Acetylene	216,000 m^3
Plants planned		
P.T. Sumber Riau (Riau)	Oxygen	60,000 m^3

Table 8. Cement production

Name and location	Product	Capacity (per year)
Plants in operation		
P.T. Semen Padang (Padang)	Portland cement	220,000 tons
P.T. Semen Gresik (Gresik)	Portland cement	500,000 tons
Perum Semen Tonasa (Tonasa, South Sulawesi)	Portland cement	120,000 tons
P.T. Jaya Readymix	Ready-mixed concrete	75,000 m^3
Plants under construction		
Extension to P.T. Semen Padang	Portland cement	110,000 tons
Extension to P.T. Semen Gresik	Portland cement	500,000 tons
P.T. Distinct Indonesia Cement Enterprise (Citeureup)	Portland cement	500,000 tons
P.T. Semen Cirebon (Cirebon)	Portland cement	500,000 tons
P.T. Salman Cement (Jakarta)	Packing plant	300,000 tons
P.T. Semen Nusantara	Portland cement	500,000 tons
P.T. Semen Cibinong (Cibinong)	Portland cement	110,000 tons
P.T. Semen Baturaja (Baturaja)	Portland cement	500,000 tons
Plants planned		
Extension to P.T. Semen Cibinong	Portland cement	700,000 tons
Extension to P.T. Distinct Indonesia Cement Enterpri.	Portland cement	500,000 tons
P.T. Indarung Indah (alongside P.T. Semen Padang)	Portland cement	500,000 tons
P.T. Amai Indah (Lhokseumawe, North Sumatra)	Portland cement	500,000 tons
P.T. Bumimajaya Utama (Rengel, East Java)	Portland cement	500,000 tons
P.T. Super Infra Chemical Industry	Domestic white cement	60,000 tons
Name not selected, sponsored by Onoda Cement Co., Japan (Biak West Irian)	Portland cement	500,000 tons
Name not selected, sponsored by Nihon Cement Co., Marubeni Corp. (West Java) and Tsurutani and Co. Ltd	White cement	120,000 tons

The problem is to locate the cement factories in such a way as to give maximum coverage to the country. P.T. Semen Gresik has an exceptionally fine research laboratory, which would be ample for the whole industry.

It is already the policy of the Government of Indonesia that the minimum scale of cement plants to be allowed for construction is 500,000 t/a on the dry process and on one kiln. For future expansion, plants are to have a capacity of twice this much. To meet international pollution prevention requirements, the plants are to be equipped with an electrostate precipitator and dust collector.

It appears that establishment of factories is keeping pace with the increase in demand and, as already mentioned, it is expected that production and demand in both cement and glass will be roughly in line by the end of Plan II.

Products from cement (except for ready-mixed concrete), such as asbestos cement, fall outside the scope of the Directorate General of the Chemical Industries as do other glass products.

The possibility of producing excess and exporting should be examined by the appropriate trade association; this position may be reached in the case of cement by 1978.

Plants of 500,000 t/a capacity are needed in Kalimantan, in or near Medan, and in North and South Sumatra. If the Asahan Dam project goes ahead, large quantities of cement will be required for the construction.

Table 9. Glass production

Name and location	Product	Capacity (t/a)
Plants in operation		
P.T. Asahimas Flat Glass (Jakarta) (Jakarta)	Sheet glass	27,900
P.T. Kangar Consolidated Industries (Jakarta)	Glass bottles	14,000
P.N. Iglas (Surabaya)	Glass bottles	24,000
Plants under construction		
Extension to P.T. Asahimas	Flat glass and sheet glass	78,120
Extension to P.N. Iglas	Glass bottles	38,610
Plants planned		
P.T. Asima Sheet Glass Factory Ltd (Medan)	Sheet glass	7,500
Plant under discussion	Safety glass	

Long-term development of paper

Table 10 shows the current situation with regard to paper production in Indonesia.

Table 10. Paper production

Name and location	Product	Capacity (per year)
Plants in operation		
P.N. Kertas Padalarang	Wide range of products	4,000 tons
P.N. Kertas Blabak	Writing paper, cartons, miscellaneous	4,500 tons
Perum Kertas Martapura	Writing and printing paper	3,000 tons
P.N. Kertas Leces	Wide range of products	9,900 tons
Perum Kertas Basuki Rachmat	Kraft paper and miscellaneous	8,500 tons
Perum Kertas Gowa	Kraft paper and others	8,800 tons
Plants under construction		
P.T. Delta Paper Mill (Medan)	Cigarette paper	1,200 tons
P.T. Inprama (Jakarta)	Tissue, napkins, toilet paper	1,500 tons
P.T. Surya Kevtas	Light-coated and wrapping paper	9,000 tons
Plants planned		
P.T. Cirebon Mercy Development Co. (Cirebon)	Printing and writing paper	9,000 tons
P.T. ACME Enterprise (Jakarta)	Wallpaper	800,000 rolls
P.T. Pulau Mursala (West Java)	Kraft-lined board, ribbed kraft paper	3,600 tons (expanding to 6,000 tons)
P.T. Saraswati Bhakti (East Java)	Coated paper	6,000 tons
P.T. Darfin (West Java) (supported by Kimberley Clark)	Pulp Tissue Cigarette paper Napkins	3,000 tons 3,000 tons 1,500 tons 28,000 units
P.T. Wijayakusuma Timber (East Kalimantan)	Pulp and paper	180,000 tons
P.T. Jaya Paper Mill (Jakarta)	Kraftboard and paper	9,000 tons

Table 1 (continued)

Name and location	Product	Capacity (per year)
P.T. Berkal Kimia Jaya (Tangerung)	Wrapping paper	4,500 tons
P.T. West Java Pulp and Paper Mill (Bekasi)	Beater-size and light-coated paper	12,000 tons
P.T. Asasi National Development Industry (Medan)	Writing and printing paper, kraft paper	30,000 tons
P.T. Anem Kosong Anem (supported by HDT Ltd)	Newsprint	68,000 tons
P.T. Tjiwi Kimia (Surabaya)	Writing and printing paper	12,000 tons
P.T. Sumber Indra Jaya (East Aceh)	Corrugated board	7,500 tons
P.T. Alas Welam (aceh)	Mechanical pulp Chemical pulp Paper products	170,000 tons 340,000 tons
P.T. Tridaya (Krawang)	Kraft paper	15,000 tons
Name not yet selected Kesaram Industries and Cotton Mills Ltd (West Java)	Viscose transparent paper	4,200 tons

The most important long-term factor affecting the development of the paper industry is the bulk supply of the correct type of wood for paper production. This involves an assessment of various kinds of wood grown on Indonesian soils followed by major afforestation of the appropriate trees in an area where both the soil is suitable and the site convenient for a paper mill. This is a very long-term programme, but should be started at once. It may be fitted in as part of the research programme of the Cellulose Research Institute. This Institute is a research laboratory where the principal activities are the testing of different types of wood for pulp production and the provision of general assistance to paper works. Work has been concentrated on the use of exhausted rubber trees, but to date it has not been found possible to avoid marks in the paper resulting from the traces of rubber left in the wood.

Some kilometres away from the Institute, there is a technical-scale plant designed to produce: pulp (right through from the raw wood); caustic soda and chlorine; and carbon disulphide. It is attached to a model rayon plant for which the pulp production was designed. This plant, however, is not in operation as it was found to be not viable. A large portion of the time was spent in producing special types of pulp for paper mills, and on follow-up laboratory work on the use of different types of timber.

UNIDO assistance (both equipment and manpower) is required to strengthen and plan anew the work of the Institute. At the time of writing, this is under consideration with UNDP.

Since rayon production has now been transferred to the Directorate General of Textile Industries, this aspect of the Cellulose Research Institute was not considered.

II. COLLECTION AND USE OF STATISTICS

The principal reasons for collecting statistics in the chemical industry are:

(a) To obtain realistic output figures and to chart output growth, thus enabling macroeconomic forecasts of the future to be made;

(b) To know how much is being produced of a certain chemical - for use in a national emergency;

(c) To obtain figures showing the relation between capital invested and value of production;

(d) To obtain figures showing the ratio of manpower to output;

(e) To plan the services, electricity, roads, telephones etc. necessary for increased production;

(f) To obtain the production and value statistics needed by upstream plants to plan their production to meet the demands of downstream plants, as one industry is the customer of another, and sometimes a customer of itself.

Statistics are only worth while if they cover the period up to the time when a study is being made; it is most important that the very latest statistics are made available for those engaged in planning activities.

Confidentiality

Statistics must be collected from every company, whether state-owned or private, but it will be found that private companies are often reluctant to disclose information and that steps may have to be taken to make disclosure compulsory. This is much easier to accomplish if the company can be assured that the information will be treated as strictly confidential and that publication will be restricted.

While a publication should therefore include as much information as possible, confidentiality must be respected. A very common procedure is to publish production figures only when there are at least three companies producing the same product or article. Sometimes, as will often be the case in Indonesia, only one company will be producing a given chemical product for many years. It may be practicable, in these circumstances, to publish the output of a number of products grouped together. Thus, if one company were producing polypropylene, another high-density polyethylene and a third low-density polyethylene, while there might be strong objections to the publication of the individual output, the objections would be much weaker if a "rolled-up" figure of the output of total polyolefines were published.

It is very important, however, not to be continually changing the system - otherwise previous statistics become almost useless. Subdivision can be helpful if properly carried out, but can produce more problems than it solves. Taking the example mentioned above, if it is possible to publish the statistics for polypropylene and low-density polyethylene separately, but as there are objections to the publication of high-density polyethylene the latter is "rolled up" with other minor plastics into an omnibus group ("other thermoplastics"), all the previously published statistics lose their value as it is no longer possible to plot the growth of polyolefines as a whole. A number of years would have to pass before sufficient data had been collected for the newly separated items to be used as the basis for growth estimates.

Current position

The Central Bureau of Statistics has in the past asked companies to disclose the nature and quantity of products they produce and the nature and quantity of materials used in the manufacture. Generally speaking, the same procedure has been adopted by the Directorate General of Chemical Industries. In the chemical industry, where a company makes one or perhaps two products using one or two clearly defined raw materials, this system can be satisfactory. As soon as production becomes more sophisticated, however, this system becomes useless. For example, one company making paper may submit statistics only for paper produced, another may divide its return between kraft and other paper, a third may differentiate between paper and board, while a fourth may submit a detailed break-down of its production. This can also happen with data on raw materials. Obviously, in preparing a national total it becomes like adding "a" to "b" and only the combined total input or output has any meaning.

The Central Bureau of Statistics recently requested companies to record what they produced under various headings. For the chemical industry, in its narrower sense, three main classifications were given:

3511 Basic industrial chemicals except fertilisers
3512 Fertilisers and pesticides
3513 Synthetic resins, plastic materials and man-made fibres

After a section for paints, pharmaceuticals and soap, there is a fourth heading, 3529: Manufacture of chemical products not elsewhere classified. It would be difficult for manufacturers to decide whether a chemical fits under 3511 or 3529. In any case, the breakdown is far too broad.

Finally there is 3540: Manufacture of miscellaneous products of petroleum and coal. It is not clear whether any petrochemicals belong in this group.

Cement is included with lime and plaster in 3692, which is quite useless. Paper is classified under 3411, along with pulp and paper board. It is not clear whether an integrated paper works is to declare the weight of pulp and then the paper made from the pulp or only the pulp is sells.

Only glass and glass products has a classification of its own, 3620, which is reasonably free from ambiguity.

These classific tions, it is clear, will not be helpful to the chemical industry. While in some ways it would have been of considerable value for the Directorate General of Chemical Industries to keep in line with this new classification system of the Central Bureau of Statistics, it is clearly of no use until the Central Bureau of Statistics adopts a much more detailed classification for chemicals and it can hardly be expected to do so just for one Directorate General.

Recommendations

In view of the above, it would seem that for the time being the Directorate General of Chemical Industries should collect its own returns from companies in its field. As compared with other Directorates General, there are very few chemical companies, though their number is increasing rapidly. This can be handled at the present time by one staff member, or at most two. This means that by careful organisation, confidentiality can be guaranteed.

A number of recommendations have been formulated as a result of a breakdown of inputs and outputs classifications drawn up and circulated to the various departments for their comments: (a) companies should be asked to submit production and sales statistics by quantity and value; (b) they should also be asked to report stocks; (c) quantities produced should be reported in gross, even if a substantial proportion is used for further processing in the same factory (this is most important); and (d) inputs should also be reported by quantity and value.

A slight problem arises when a company transfers a product for further processing, e.g. ammonia to make caprolactam, to another branch of the same company or to an associated company, that is, a company in which there is a partial ownership. To answer the question of whether such a transfer should count as a sale or not, the type of information needed by the Government must be considered. It needs first the total output of a given chemical, what happens to it afterwards and whether it is further processed in the same works, transferred to another or sold in the open market (domestic or foreign). This is to enable the Government to know what is available and what could be diverted to other uses in an emergency. It also needs to know the value of the output of the industrial sectors. To obtain this, it needs the value of products transferred from the chemical industry sector to other industrial sectors. From this angle, whether a transfer to an associate company counts as sale or not is immaterial as long as one counts it as a sale and the other a purchase or neither counts it at all. Clear instructions must therefore be given as to how such transfers/sales should be treated. It is recommended that all transfers from one undertaking to another be recorded as sales whether or not owned by the same concern.

A much more serious complication will arise when a company attached to another Directorate General starts producing one of the products of the Directorate General of Chemical Industries, e.g. a paint company making urea formaldehyde resins. It is essential that its output of these resins be returned, otherwise the total for the country will be too low. It is assumed that before starting production, the company will have to receive the permission of the Directorate General of Chemical Industries so that its activity in this field will be known. Not only must it report its production of urea formaldehyde resins, it must report the value of the resin it transfers to its paint plant, otherwise the figures for the total value of the chemical industry will be too low. As far as is known at present, this complication has not arisen, but it will eventually. The large textile companies will make their own resins for crease resistance; pharmaceutical companies will make their own chemicals, e.g. acetyl salicylic acid; detergent formulators will make their own alkyl benzene sulphonate etc.

It must be made quite clear then whether production and sales returns are to be made gross or net. If the product is sold as a solution or emulsion, should the weight sold include the solvent, often just water, or should the weight be the net solid content (or active matter)? This applies to pesticide solutions and emulsions, polyvinyl acetate emulsions, urea formaldehyde resins and such products as solutions of hydrochloric acid. It is not sufficient merely to record the strength, e.g. 50 kg of hydrochloric acid, as it is ambiguous; it is not clear whether it refers to 50 kg of solution or 50 kg of hydrogen chloride in a solution at 33 per cent strength. To obtain unambiguous returns, it is essential to frame questions in such a way that no ambiguity can result (see draft questionnaire below).

On balance, it is recommended that companies be asked to return their production sales gross and to state the concentration of active matter. The latter can in many cases be checked from the inputs. Also, the units in which the outputs are to be expressed should be clear, e.g. volume or weight.

Draft questionnaires

PURCHASES

Product	Weight (tons)	Value (Rp.)	Imported or domestic

PRODUCTION

Product	Weight (tons)

SALES

Product	Weight (tons)	Value (Rp.)	Imported or domestic

STOCKS

Product	Weight (tons)

Notes:

(a) Enter under PURCHASES the quantity bought of each product and the price paid. Delivery charges and non-returnable packages should be included; returnable packages should be excluded. Where the product purchased is in solution or emulsion form, enter the gross weight and give the concentration of active matter.

(b) Enter under PRODUCTION the gross weight of each product, whether or not it is to be used for further processing in the works or sold or transferred to another works. Again, when made in the form of a solution or emulsion, give the gross weight and the concentration of active matter.

(c) Enter under STOCKS the total weight of each product in stock at the end of the period for which the return is being made. When the stocks are in the form of a solution or emulsion, record the gross weight and the concentration of active matter.

(d) Enter under SALES the net weight (i.e., excluding packing) of each product sold and its ex works value, including non-returnable packaging. If the product is subject to a sales tax, exclude this from the value returned. If the product is in solution or emulsion, return the total net weight (i.e., again excluding packages) and the concentration. Record as sales any product transferred to another works whether under common ownership, the ownership of an associated company or that of a third party. Include any commissions paid on the sales to own salesmen or to agents. Where, however, a discount from the list price has been given to a purchaser, the net price should be recorded.

It must be made perfectly clear that information returned on this questionnaire will be treated as strictly confidential and in no circumstances will it be made available to anyone other than senior government officials. Publication of country totals will only be made when at least three companies are making and/or selling the same product. Any company may request that publication be suspended even in these circumstances. This will be given favourable consideration in cases where one of the producing companies is much larger than the other two.

Classification of products

Listed below are the manufactured products and raw materials it is recommended should be included in each sector. It will be appreciated that in some sectors the same products appear both as finished products and as raw materials.

3411: Manufacture of paper and board

Products

01 Newsprint
02 Printing and writing paper
03 Kraft paper and board
04 Box board
05 Cigarette paper
06 Other wrapping and packaging paper
07 Speciality paper
08 Coated paper

Raw materials

50 Straw and rice stalks
51 Long-fibre wood
52 Short-fibre wood
53 Alum
54 Aluminium sulphate
55 Bleaching powder
56 Calcium stearate
57 Caustic soda
58 Chlorine
59 Dyestuffs
60 Hydrogen peroxide
61 Salt
62 Soda ash
63 Antifoam
64 Glue
65 Resin
66 Scrap paper
67 Styrene butadiene latex
68 Tapioca flour
69 Whitening agent
70 Other sources of cellulose
71 Others

3511: Manufacture of chemicals other than plastics, synthetic fibres and pesticides

Products		Raw materials	
01	Acetone	50	Air
02	Ammonia	51	Ammonia
03	Benzene	52	Benzene
04	Bleaching powder	53	Carbon monoxide
05	Butyl alcohol	54	Carbon dioxide
06	Calcium carbonate	55	Chlorine
07	Calcium sulphate	56	Cyclohexane
08	Carbon dioxide	57	Cyclohexanol
09	Caustic soda	58	Di-2 ethyl hexanol
10	Dibutyl phthalate	59	Ethylene
11	Di-2 ethyl hexanol phthalate	60	Fuel oil
12	Ethyl alcohol	61	Gas
13	Ethyl benzene	62	Hydrogen
14	Ethylene	63	Isopropyl alcohol
15	Ethylene oxide	64	Lime
16	Ethylene glycol	65	Methanol
17	Formaldehyde	66	Phosphoric acid
18	Formic acid	67	Phthalic anhydride
19	Hydrochloric acid	68	Propylene
20	Isopropyl alcohol	69	Salt
21	Liquid air	70	Sulphur
22	Maleic anhydride	71	Sulphuric acid
23	Methanol	72	Ortho xylene
24	Nitric acid	73	Para xylene
25	Nitrogen	74	Others
26	Oxygen		
27	Phosphoric acid		
28	Phthalic esters (other)		
29	Phthalic anhydride		
30	Propylene		
31	Sodium carbonate (soda ash)		
32	Sodium chlorate		
33	Sodium hypochlorite		

34 Sodium sulphate

35 Sodium tripolyphosphate

36 Styrene

37 Sulphur dioxide

38 Sulphuric acid

39 Styrene

40 Urea (technical)

41 Others

3512: Manufacture of fertilizers and pesticides

Products

01 Ammonia-ammonium nitrate solutions

02 Ammonia-urea solutions

03 Ammonium chloride

04 Ammonium nitrate

05 Ammonium sulphate and nitrate

06 Amminium sulphate

07 Calcium ammonium nitrate

08 Calcium cyanamide

09 Calcium nitrate

10 Compound fertilisers

11 Diammonium phosphate

12 Dicalcium phosphate

13 Double superphosphate

14 Fused magnesium phosphate

15 Mono ammonium phosphate

16 Natural fertilisers

17 Potassium sulphate

18 Potassium chloride

19 Single superphosphate

20 Sodium nitrate

21 Sulphate of potash-magnesia

22 Triple super phosphate (TSP)

23 Urea

24 Urea ammonium phosphate

Raw materials

50 Ammonia

51 Carbon dioxide

52 Gypsum

53 Lime

54 Nitric acid

55 Phosphoric acid

56 Potassium chloride

57 Potassium sulphate

58 Rock phosphate

59 Sulphur

60 Sulphuric acid

61 Active ingredients not elsewhere specified

62 Chlorpropionic acid

63 Dithiocarbamates

64 Emulsifying agents

65 Ethylene dichloride

66 Methyl ethyl ketone

67 Organic phosphorus compounds

68 Petroleum spirit

69 Phenoxyacetic acids

70 Propellants

71 Pyrethrum

72 Solvents not elsewhere specified

73 Others

25 Other fertilisers

26 Fungicides

27 Herbicides

28 Insecticides

29 Rodenticides

30 Other pesticides

3513: Manufacture of synthetic resins and plastic materials and synthetic fibres except glass

Products

01 Polyethylene powder

02 Polyethylene film or sheet

03 Polyethylene tubes

04 Other polyethylene form as raw material

05 Polypropylene powder

06 Polypropylene film or sheet

07 Polypropylene tubes

08 Polypropylene fibres

09 Other polypropylene form as raw material

10 PVC resin powder

11 PVC compounds for production of rigid products, flexible products and plastisol products

12 PVC rigid film or sheet

13 PVC flexible film or sheet

14 PVC rigid tubes and pipes

15 PVC flexible tubing

16 Polystyrene resin crystal

17 Polystyrene resin impact, modified

18 Polystyrene resin emulsion

19 Other polystyrene resin form as raw material

20 Other thermoplastic resin

21 Other thermoplastic film or sheet

Raw materials

50 Acetylene

51 Acrylic esters

52 Acrylonitrile

53 Ammonia

54 Benzene

55 Caprolactam

56 Caustic soda

57 Cresols

58 Cyclohexane

59 Dibutyl phthalate

60 Dimethyl terephthalate

61 Dioctyl phthalate

62 Ethylene

63 Fabric cotton

64 Fabrics, other than cotton

65 Fibres

66 Fillers, wood flour

67 Fillers, other than wood flour

68 Formaldehyde (formalin)

69 Hexamethylene tetramine

70 Hydrogen chloride

71 Isocyanates

72 Maleic anhydride

73 Melamine

74 Methyl methacrylate

75 Oxygen

22 Other thermoplastic tubes
23 Phenol-formaldehyde resins
24 Phenol-formaldehyde moulding powders
25 Urea formaldehyde resin
26 Urea formaldehyde moulding powders
27 Unsaturated polyesters resins
28 Flexible polyurethane foam
29 Other thermosetting resins
30 Plastic laminates
31 Polyamide fibres
32 Polyester fibres
33 Other man-made or synthetic fibres
34 Polyvinyl acetate, polyacrylate and co-polymer emulsion
76 Paper for laminates
77 Phenol
78 Phthalic anhydride
79 Polyols
80 Propylene
81 Propylene glycol
82 Stabilizers
83 Styrene
84 Sulphuric acid
85 Synthetic rubber
86 Terephthalic acid
87 Urea
88 Vinyl acetate
89 Vinyl chloride
90 Materials not elsewhere specified

3551: Manufacture of tires and tubes

Products

01 Passenger car tires
02 Tires for trucks and buses
03 Motorcycle tires
04 Bicycle tires
05 Tires not elsewhere specified
06 Inner tubes for passenger cars
07 Inner tubes for bus and truck tires
08 Inner tubes for motorcycle tires
09 Inner tubes for bicycle tires
10 Inner tubes for other tires
11 Solid tires
12 Giant tires
13 Retreads

Raw materials

50 Solid natural rubber
51 Natural rubber latex
52 Butyl rubber
53 Other synthetic rubber solid
54 Other synthetic rubber latex
55 Carbon black
56 Zinc oxide
57 Stearates
58 Curing agents
59 Antioxidants
60 Scorch inhibitors
61 Tire canvas, cotton
62 Tire canvas, rayon
63 Tire canvas, polyester
64 Tire canvas, nylon
65 Tire canvas, other
66 Tire cord

3620: Manufacture of glass and glass products

Products

01 Bottles
02 Bottle glass
03 Drinking glasses and containers
04 Fibre glass
05 Laminated glass
06 Mirrors
07 Optical glass
08 Safety glass, other than laminated
09 Sheet glass
10 Glass products not elsewhere specified

Raw materials

50 Adhesive
51 Arsenical glass
52 Borax
53 Dolomite
54 Fire bricks/refractories
55 Lime
56 Limestone
57 Manganese dioxide
58 Quartz
59 Powdered glass
60 Sodium carbonate
61 Sodium nitrate
62 Sodium sulphate
63 Materials not elsewhere specified

3692: Manufacture of cement, lime and plaster

Products

01 Cement
02 Lime
03 Plaster
04 Ready-mixed cement
05 Cement products not elsewhere specified

Raw materials

50 Calcium sulphate synthetic
51 Clay
52 Dynamite
53 Fire bricks
54 Gravel
55 Gypsum
56 Iron sand
57 Kraft paper
58 Limestone
59 Quartz
60 Sand
61 Stone
62 Other products

The following additional information should be collected from each company:

Fuel consumption

Fuel and power		Quantity (state units)	Value
Consumption of electricity (own generation)			
Consumption of electricity (purchased)			
Consumption of gas	for generation of electricity		
Consumption of fuel oil	for generation of electricity		
Consumption of gas	for other purposes		
Consumption of fuel oil	for other purposes		
Stocks of fuel oil			

Employment

Number employed at end of period covered in report	Total annual salaries and wages
Technical and managerial staff	
Foreign	
Indonesian	
Workers	
Foreign	
Indonesian	

Interpretation of statistics

By simple arithmetic computation, a large number of useful ratios can be obtained, giving information about how a company or an industry is progressing. The following are some examples:

(a) The ratio of quantity of product or products made to the quantity of products or products consumed gives a measure of the efficiency of the operation;

(b) The ratio of quantity of product produced to manpower employed gives a measure of the efficiency in the use of labour. This must be interpreted with great caution. While process workers per unit of production normally decreases with increasing scale of production, ancillary workers may actually increase owing to the various new facilities that have to be provided and the inevitable decentralisation of management. Generally speaking, therefore, these comparisons should be confined to works of the same order of size;

(c) The ratio of quantity produced to consumption of power and/or fuel is valuable as it gives some idea of how future increases in the price of oil and gas are going to affect the cost of the product and if it were ever decided to subsidize fuel for a given industry, ample statistics would be available to support the decision.

Financial matters have been deliberately excluded because at the present time currencies used in international trade are subject to substantial inflation and it is therefore not easy to devise a simple system that can take account of present and future inflation. Thus, a comparison of return on capital employed by two companies, one of which was set up three years before the other, is misleading under present circumstances. Also, questions of profits and depreciation are so bound up with tax considerations that statistics based on profits are misleading. As every company will do its best to report the minimum profit, measuring profit as an indication of efficiency is not valid; it may show only which company has the more competent accountant.

The time may come, or may have to come, when all values are index linked, i.e. a percentage degree of inflation issued at intervals, say every six months, that will affect all payments including prices, wages and sales of interest. In such cases it might be possible to reduce all value figures to a norm, from which meaningful comparisons could be established.

The other main use of these statistics is to try to plan for the future. The demand for a product for a particular year can be calculated by adding together production and imports and substracting exports and increases in stocks. Until production is on a substantial basis, the major factor determining consumption will be imports. The Central Bureau of Statistics classifies imports by a system very closely related to the Brussels Tariff Nomenclature, but so far only one year is available and there are still some doubts about the units in which these are collected.

To forecast future demand, the ideal is to have the demand figures for a large number of back years available; then a simple projection gives useful results, specially for only five or so years ahead. However, when the back figures have been distorted by political changes, this method is of little use.

In such a case it is important to establish the demand for a previous year, preferably as recent as possible. Unless it is a product that is being rapidly replaced by another product, it can be assumed that the increase in demand will not be less than the sum of the annual per cent increase in <u>per capita</u> GNP and in population. If it is a new product with potential outlets in a number of fields, demand is likely to grow much faster than this and the best way is to see what information exists in the growth of demand in other countries, preferably those in a similar or slightly more advanced state of development than Indonesia. If the demand for a product can be related to the GNP in a number of countries including Indonesia, it can be seen whether related to the stage of development represented by the per capita GNP, Indonesia is behind or ahead of other countries in its consumption of the particular product. Unless there are special factors involved - climate, customs etc. - it can be assumed that if the demand:GNP ratio is low compared with other countries, the growth rate will be high, and of course the reverse. These are only indications; the final decision is left to the skill and experience of the planners.

It should be added that in 1971 the Central Bureau of Statistics carried out a very thorough investigation of output and input in Indonesia and the results were published on an industry basis. These were examined in detail in an attempt to discover how much of the principal chemicals were consumed by various industries. Unfortunately, the total of all chemicals consumed fell well below imports plus production, and many industries reported a very large tonnage of chemicals under the "miscellaneous" heading. Further, it is probable that the biggest consumer of chemicals, the oil industry, was not included in the survey at all.

It is strongly recommended that another, similar survey be carried out, but it should embrace all industries including those outside the Ministry of Industry, and most certainly the oil industry. Also, inputs should be classified so that the major chemicals are kept distinct and not reported under an omnibus classification. This would be a great help to planners as it would show the distribution of the use of the main chemicals among the various industries; the future demand for a chemical could then be related to the planned growth of a particular industry. The Directorate General of Chemical Industries should press for such a survey to be carried out. It would also be of interest to other Directorates General.

III. EVALUATION OF PREVIOUS FEASIBILITY STUDIES AND DISCUSSION OF SECTORAL STUDIES

Feasibility studies

Survey of the Petrochemical Industry of Indonesia (Japanese Gasoline Co.)

Sponsored by UNIDO, the survey was carried out in 1972 and the report completed in 1973 before the great surge in crude oil prices and before the world inflationary trend became so obvious. The conclusions regarding prices and costs therefore must be substantially revised to be applicable to present circumstances.

The market estimates were built up largely on international comparisons and Japanese export figures to Indonesia; they are summarised as follows, in thousands of tons:

	LDPE	HDPE	PVC	Polystyrene	PP	Nylon	Polyester
1975	36	11.5	38	9	17.5	10	34
1978	63	16	59	16.5	36.5	16	59
1980	90	20	80	25	60	20	80

About two fifths of the survey was devoted to market estimates and other information concerning plastics in other South-East Asian countries, Japan and the Republic of Korea.

Prices were estimated on the assumption that they would rise by 2 per cent annually. It was recommended that the following products be made in Indonesia: VCM, PVC, LDPE, HDPE, ethylene glycol, polystyrene, caprolactam and terephthalic acid.

Discounted cash-flow techniques were used to estimate economic feasibility and it was assumed that base chemicals would show a rate of return of at least 7.5 per cent and downstream products at least 10 per cent or preferably 15 per cent. As 20 per cent interest can be earned from long-term deposits in banks, these figures are unrealistic.

Two schemes were considered, one based on naphtha cracking, the other on natural gas condensate cracking and naphtha reforming.

In the first scheme, about 1 million tons of naphtha were cracked to yield 300,000 t/a ethylene, 140,000 t/a propylene and 120,000 t/a of C_4 hydrocarbons, together with 217,000 tons of gasoline, which would yield by selective hydrogenation and extraction 76,000 t/a benzene (including that made by disproportionation of toluene) and 25,000 t/a p-xylene (including products from disproportionation of toluene and isomerization carried to it's limit). A little more than half the benzene would be converted to cyclohexane (for caprolactam, 33,000 t/a) and the whole of the p-xylene converted to 35,000 t/a. From the olefin fractions would be produced 16[illegible],000 t/a LDPE, 35,000 t/a HDPE, 15,000 t/a ethylene glycol, 110,000 t/a PVC, 50,000 t/a polystyrene (with benzene from the extraction plant) and 60,000 t/a polypropylene. Some of the propylene would be converted via the oxo process to 2-ethyl hexanol which, with phthalic anhydride made from imported o-xylene, would be converted to 60,000 t/a dioctyl phthalate.

In the second scheme, natural gas condensate would be cracked to give olefins and naphtha reformed to give aromatics. First 216,000 t/a ethylene and 55,000 t/a propylene would be produced from condensate cracking from which would be produced 100,000 t/a LDPE, 26,000 t/a HDPE, 60,000 t/a PVC, 30,000 t/a ethylene glycol and 30,000 t/a polystyrene. In the aromatics plant, 50,000 t/a benzene (for styrene and 24,000 t/a caprolactam) and 50,000 t/a p-xylene (for 71,000 t/a TPA) would be produced.

The discounted cash-flow rates of return, with five years tax holiday, were 13.4 per cent in the first scheme (which would come on stream in 1980) and 13.1 per cent in the second scheme (which would come on stream in 1977).

As mentioned above, these results would need to be completely revised in order to have any meaning at the present time.

<u>Survey on the Development of the Petrochemical Industries (Unico)</u>

This bilaterally sponsored survey carried out in 1974 is very long and complex and is spoilt by the fact that the text is separated from the tables and charts and placed in different volumes, which makes reading very slow and difficult. Apart from this criticism, however, it is a very thorough piece of work. It is the first survey to grip firmly the inflationary situation. It assumes a 7 per cent annual increase in all costs and prices, bases crude oil on a Mideast crude oil price of $9.36 per barrel and assumes this will escalate by 7 per cent annually.

Costs are worked out in great detail for an aromatics project and an ethylene and derivatives project based on naphtha or natural gas condensate at three different sites: a 300,000 t/a ethylene project in North Sumatra (Rantau), and East Kalimantan complex based on 450,000 t/a ethylene, and an ethylene plant in Palembang with a capacity of 200,000 t/a.

Although the results are interesting, they have been overtaken by events and Unico has been asked to reissue its survey based on a 450,000 t/a ethylene plant using ethane from the Arun gas field in North Sumatra.

If the text had been better arranged, it would have made a most informative report. Besides the separation of text and charts, there is a great deal of duplication and the text could have been condensed into half. The chart showing the effect of capacity, time for construction, raw material costs, and finished products costs on the discounted cash-flow rate of return is especially useful, and many other diagrams and charts are of interest. On the other hand, there are no clear-cut recommendations.

No new market survey had been done, and the report accepted basically the statistics given by the Japanese Gasoline Co. The same Unico team simultaneously conducted feasibility studies on detergents, plastics and synthetic rubber. Unico also conducted surveys on synthetic fibre and rayon in mid-1972, the report of which was issued in February 1973, and on raw materials for synthetic fibres, the field survey conducted in December 1973 and the report issued in June 1974.

National Fertiliser Study (Indonesia)

The survey was conducted by Agrar and Hydrotechnik GmbH and Imhausen International Co. GmbH.

It is a six-volume survey carried out between June 1970 and June 1971 and done in great detail. The report was issued in October 1972.

The survey covered agronomy, farm management investigations, fertiliser prospects, distribution, statistics and current and recommended future manufacture. It drew attention to the fact that ammonium sulphate is always more suitable than urea as a "top dressing" fertiliser. Urea must be worked into the soil or applied under water. The demand for N, P and K fertilisers was estimated as follows (in thousands of tons):

	N	P_2O_5	K_2O
1975	345	147	89
1980	563	296	168

It was further estimated that 443,000 tons of this N and 170,000 tons of P_2O_5 would be produced in Indonesia by 1980.

It was recommended that the partially-constructed superphosphate project at Cilacap should be reconstructed to make mono-ammonium phosphate, which should be combined with urea in granular form to make a 27-27-0 compound. It is understood that this project has been abandoned, and that imported phosphoric acid will be used. The possibility of using the dual process at Gresik to make soda ash and ammonium chloride was rejected because of doubts regarding the market for soda ash. Tests on Sawah rice showed that an N content, urea, ammonium sulphate and ammonium chloride were equal.

At the time that this survey was conducted, Pusri III and the plants in East Kalimantan and Cilacap were not established or at any rate were not taken into account, which makes the over-all recommendations rather out of date now. The sections on agronomy, distribution etc. do, nevertheless, make worth-while reading.

Proposal for the Development of the Nitrogen Production Capacity in Indonesia

This survey was conducted by P. C. Williamson and the report issued in April 1974. It deals specifically with recommendations for Indonesia's future nitrogen production. It recommends that a fifth nitrogen unit be installed in West Java, with a capacity of 525,000 t/a of ammonia. A sixth Pusri III should be established in Sumatra, near a deep-water port, or a site in East Kalimantan should be used. A delay of a year or two should be allowed before the start-up of the seventh, to allow the demand picture for the eighties to become clearer; the unit should occupy the alternate site of the sixth.

Only low-cost natural gas feedstock should be used, and it should not compete with gas charged to LNG or power generation. Small vessels could be used to transport nitrogen to the various South-East Asian markets.

The N balance is shown in table 11.

Table 11. The N balance in Indonesia
(Thousands of tons)

	Demand		Production			
	Based on [illegible] fore-cast and extra production	Based on [illegible] study	Based on existing plants and East Kalimantan	Basis includes Pusri III	Basis also includes West Java	Basis also includes East Kalimantan
1974	554	336	144	144	144	144
1975	687	441	238	238	238	238
1976	[illegible]	484	304	304	304	304
1977	837	528	563	696	[illegible]	828
1978	[illegible]98	571	563	888	1,1[illegible]5	1,345
1979	1,[illegible]	613	563	888	1,1[illegible]5	1,537
1980	1,17[illegible]	654	563	888	1,1[illegible]5	1,53[illegible]
1981	1,262	696	563	888	1,1[illegible]5	1,53[illegible]
1982	1,36[illegible]	737	468	793	1,[illegible]1[illegible]	1,442
1983	1,44[illegible]	77[illegible]	468	793	1,[illegible]10	1,442

The Pusri III plant is to start production in March 197[illegible]; the West Java plant in July 1977; and Kalimantan II in July 1978. Pusri I and Petrokimia are to close in 1982.

The capital cost of a 330,000 t/a ammonia plant based on natural gas was estimated in January 1974 to be $100 million including all auxiliary and support facilities together with liquid storage. For a corresponding urea plant, the investment needed would be $36.5 million and $50 million for a 550,000 t/a plant.

If naphtha costs $110 per ton, natural gas could cost $2.55 million/ft^3 and remain competitive.

Unfortunately, although the survey is most thorough and detailed, it was too early to take into account the major increase in crude oil and hence gas prices; nor does it appear to allow any inflation coefficient for capital costs. (A useful formula would be one in which current capital and process costs, an inflation coefficient and a cost-of-raw-material coefficient could be inserted to bring the figures up to date at short notice. The tendency to ignore inflation is noticeable in surveys carried out even as recently as the beginning of 1974.) Some interesting charts are given showing how the cost of producing a ton of ammonia varies with the cost of natural gas, all other factors remaining the same. Figures for a 330,000 t/a ammonia plant are given as:

Price of natural gas (900 Btu/ft^3) (Dollars/thousand ft^3)	Cost of producing ammonia (Dollars/ton)
0.20	40
0.40	47
0.60	55
0.80	63
1.0	72
1.5	91
2.0	111
2.5	130

Pusri has issued a report that shows the effect of the increased cost of natural gas on the cost of urea (330,000 t/a ammonia, 550,000 t/a urea) as follows:

Price of natural gas (900 Btu/ft^3) (Dollars/thousand ft^3)	Cost of producing urea (Dollars/ton)
0.225	45
0.45	53.5
0.675	62.5
0.90	69

However, neither Pusri nor Williamson pay any attention to inflation.

Proposals for the Development of a Phosphate Fertiliser Industry in Indonesia

This study by F. P. Hignett (April 1974) recommends that:

(a) Plans for the production of phosphate fertiliser should be deferred for two years and then a fresh study carried out;

(b) Only if Indonesia is prepared to subsidise the operation should TSP and/or compound fertilisers be produced from imported phosphoric acid;

(c) The possibility of producing sulphuric acid as an adjunct to copper smelting should be explored;

(d) The exchange of nitrogen for phosphate fertilizers with the Philippines should be considered. ([illegible] considered that this should be emphasized.)

A world surplus of phosphate fertilizers is expected over the next five years. Further, Indonesia is not advantageously placed for obtaining rock phosphate at a competitive price. The possibility of the Broken Hill South deposits in Queensland being used from [illegible] onwards does not seem to have been fully investigated nor has the possibility of combining sulphuric acid production for TSP with use of the same product for [illegible], which should appreciably spread the project's overheads.

National Pulp and Paper Survey

Conducted by Sandwell and Co. Ltd in March 1972, this survey covers ground similar to that of the Buttner and van [illegible] surveys, but goes into much more detail as regards sources of raw materials and types of forest (their ownership, administration and suitability for paper production).

The long-fibred pine plantations and forests of Central Java were recommended as the most suitable for development for raw materials and detailed studies were advised on the availability of land, the standing volumes by area and age classes, expected yields and the development of a logging road system. Rice straw and bamboo were not considered to have any significant potential for development, but the sugar industry in East Java was considered able to produce bagasse. Also recommended were the manufacture of writing and printing papers at Leces in East Java, the manufacture of these together with liner board, sack kraft and bleached market pulp from pine and agathis wood at Cilacap, and the manufacture of corrugating board bagasse at Banyuwangi and box board (from waste paper) in Jakarta. A newsprint industry was not considered to be profitable.

For the long term, the pine forests in the Aceh region should be exploited but the tropical hardwood forests in Kalimantan did not offer prospects for a profitable industry although they contained species suitable for pulping.

Two sets of market projections, based on economic growth rates of 5.5 and 6.5 per cent annually were presented, as shown in table 12.

This seems to represent the most satisfactory breakdown of paper types and it is recommended that it be adopted for all statistics and future surveys so that the results may be comparable.

Table 12. Projected paper and board consumption
(Thousands of tons)

	5.5 per cent growth		5.5 per cent growth	
	1975	1980	1975	1980
Newsprint	60	90	65	105
Printing and writing paper	110	175	125	215
Kraft paper and board	40	65	50	85
Box board	20	35	25	45
Cigarette paper	6	7	6	8
Other wrapping and packing paper	18	30	18	35
Speciality paper	11	18	11	27
Total	265	420	300	520

The Sandwell report describes in some detail the existing mills and developments needed, but concentrates its suggestions more on producing the right quantity of the right type of paper rather than on modifications to the mills themselves, although these are not neglected.

The authors of the Sandwell report do not deal with engineering problems in detail as does van Doosselaere (below), but generally speaking this is a more satisfactory report.

Pulp and Paper Industry

The report by G. C. van Doosselaere is dated September 1972. After describing briefly the current situation in the paper industry, mention is made of the low or nil profitability, the difficulty of getting loans at a reasonable rate of interest, and hence the shortage of capital for new investment. As the paper mills are all state-owned and operate quite independently, one of the recommendations is that some form of unified management be set up. (This was seriously considered for a time but it has now been decided not to proceed with this partial amalgamation.)

Each mill was considered separately, from both technical and managerial points of view. Padalarang was not considered in detail as it was employing specialist consultants. Blabak, which makes about 14 tons per day from rice straw, was limited in its ultimate capacity to some 60 tons per day, owing to the limitation of available water. A programme for expansion was recommended. Leces installed a new pulp and paper mill in 1969 with a capacity of 22 tons per day, but it is too small to be viable. As ample water is available, it was recommended that the capacity of the new mill be increased to 50 tons per day and the capacity of the old (10 tons per day) plant doubled. It was considered that this would about satisfy the 1980 market for writing and printing paper and that the expansion should be put into effect in 1977.

Banyuwangi uses bamboo wood as a raw material. A 50 per cent increase in production capacity for writing and printing paper was recommended, but with no increase in the pulp production. Gowa was being served by an advisory team from the Honshu Paper Co. Martapura uses agatha wood and its poor location (in South Kalimantan) made any major increase not practicable. Improvements to the handling methods were recommended, however.

Management problems are discussed in detail. One of the difficulties is that the mill manager needs to be on the spot all the time to keep the mill running efficiently. Improvements in the processing and availability of information were recommended. It was also recommended that a number of experts act as advisers to the management of the mills.

The weakness of this report is the lack of summary and conclusions. Also, as the recommendations are spread throughout the report rather than being concentrated in one place, the effect of one recommendation on another cannot clearly be seen.

Advice on Management of State-Owned Indonesian Paper Mills (called the Dittmer Report)

In December 1973, Gollwitzer Ingenieurplanung und Co. undertook a considerable study of the paper market. Although various estimates were compared, no firm conclusions were reached, except that the estimated consumption of all types of paper was 160,000 tons in 1971 and would reach 400,000 tons in 1980 and 1.3 million tons in 1990. An interesting section of the report compares the quality of paper produced in Indonesian mills with German standards. Each of the paper mills was visited, its current position described and improvements recommended. These are set out much more succinctly and clearly than in the van Doosselaere report, but mechanical and engineering problems are not dealt with. Finally, a major section is given to managerial techniques, with an excellent summary and recommendations. The report agrees with the van Doosselaere report in proposing a merger scheme. A standard paper classification for production and import export statistics was recommended. Concentration on printing, writing and packaging paper was recommended. An agreement should be reached with other South-East Asian countries about newsprint. Household, sanitary and tissue paper should continue to be imported.

Technology transfer India-Indonesia

While this report, written by V. K. Chebbi in August 1973, is primarily a survey of the possibilities and methods of transferring technology between India and Indonesia, it contains some worthwhile suggestions for development projects in the chemical field. Many of these projects are now in implementation or at the planning stage. Those remaining, which are perhaps worth further consideration as small-scale industries, are shown in table 13.

Table 13. Projects worth considering as small-scale industries

Raw materials	Capacity suggested (t/a)	Products
Magnesium sulphate	[illegible]	Paper, ceramics, pharmaceuticals
Precipitated calcium carbonate	1,[illegible]	Rubber, paints, cosmetics
Chlorobenzene	35[illegible]	Dyestuff intermediates, herbicides
Aspirin	35	Pharmaceuticals
Nitric acid	35[illegible]	Chemical industry generally
Activated carbon	350	Decolourizing, oils, glucose, dextrose
Magnesium carbonate (light)	175	Rubber, paints

With the exception of the nitric acid project, it is doubtful whether any of these would be really viable except behind a high tariff wall, but production of such projects should be encouraged in order to get wider segments of the chemical industry into operation.

UNIDO/FAO Prefeasibility Survey of Pesticide Production in Indonesia

The study was carried out in [illegible] by [illegible] and [illegible] Mayer. It gives the following quantities of pesticides imported in [illegible] (on active ingredient basis):

	Tons	
Chlorinated hydrocarbons		
DDT	[illegible]	(believed to be on 75 per cent wettable powder basis)
All others	51	
Organic phosphates	[illegible]	
Carbamates	[illegible]	
Other insecticides	[illegible]	
Fungicides	[illegible]	
Herbicides		
Dalapon	764	
2,4-D	[illegible]	
MCPA	[illegible]	
Sodium arsenate	[illegible]	
Others	28	
Fumigants		
Ethylene dibromide	41	
Methyl bromide	37	
Others	18	
Others	43	

The estimated demands for finished pesticide products, including those for malaria control, are given in table 14.

Table 14. Estimated demands for pesticides (Tons)

	Insecticides	Fungicides	Herbicides
1971	2,413	629	1,643
1972	3,200	431	1,904
1973	4,000	474	2,380
1974	4,400	521	2,975
1975	8,400	574	3,719
1976	8,300	631	4,649
1977	9,200	694	5,811
1978	9,500	764	7,264
1979	10,600	840	9,080
1980	11,700	924	11,350

The report recommends that:

(a) 5,000 tons per year DDT plant be constructed in the Surabaya area;

(b) A 3,000 tons per year BHC plant be constructed in West Java;

(c) 2,4-D and MCPA with imported chlorophenols and chloractic acid be produced locally;

(d) Production of phosphorus insecticides should be considered;

(e) Co-operation with the Philippines should be sought in the manufacture of BHC.

Formulators of pesticides are listed, as well as those intending to come on stream. The list is slightly optimistic and incorrect in some ways, however:

(a) P. T. Bona Spes has never been on stream and is in some difficulties owing to the death of its chief executive;

(b) Ciba Geigy is planning to formulate diazinon, but political factors have led to considerable difficulties and it is understood that this is in abeyance;

(c) Petrokimia's plan for production and formulation of diazinon with Nihon Kayaku's assistance is still on the programme, but the expert recommends that these activities be transferred elsewhere;

(d) P. T. Pacific Chemicals (Dow) is erecting facilities for formulating dalapon, but no other activities are contemplated in the immediate future;

(e) Concerning BASF, there are no developments.

(Table 4 shows the current situation with regard to pesticide production.)

Similarly, the survey of the production of base chemicals that could be used in the production of finished chemicals contains certain inaccuracies:

(a) P. T. Taras Pakartan is not going ahead with chlorine/caustic soda production as its application was ultimately refused owing to the location;

(b) The plant mentioned for the manufacture of carbon disulphide is available, but current recommendations are that the rayon plant be put "in mothballs". It has not been operated for some time owing not to technical difficulties, but to its not being able to turn a profit;

(c) Copper smelting is being considered at Petrokimia Gresik and the resulting sulphur is being used to make sulphuric acid;

(d) Plans are now under way to produce surfactants (see table 6).

Macroeconomic sectoral studies

The expert was asked to firm up departmental estimates for paper, cement and fertilisers and also to gather some material on plastics for a lecture to Lemigas.

Paper

As so many different estimates have been made for the demand for paper, it was practicable only to examine and compare these estimates and try to obtain a fair mean estimate. The various figures are shown in table 15 (see also figure [illegible]).

Up till 1970 the figures represent what the authors of the reports believed the actual consumption to have been; after 1970 they are mixed, depending on the actual data of the report. Therefore, the mean figures up till 1970 have been plotted, then the "actuals" supplied by the Directorate General of Chemical Industries have been taken and projected to 1980. This gives the following figures (thousands of tons):

1974	1975	1976	1977	1978	1979	1980
315	375	440	520	600	680	780

This implies a growth rate of 19 per cent between 1974 and 1975, falling to 14.7 per cent between 1979 and 1980. This is not considered exorbitant, taking into account the increase in GNP, the increase in population, and the growth in literacy. Even in 1980 the per capita consumption on this basis will only be of the order of 5.5 kg compared with Malaysia which was 14.6 kg in 1970 and Japan, 121.6 kg in the same year.

It has been pointed out that government credits for paper were withdrawn in April 1974, that apparent consumption in 1973 may be misleading, and that there may even be a fall in 1974. Nevertheless, it still seems likely that the Plan II figures are too low; on a purely macroeconomic basis, something of the order of the projected figures should be reached.

Cement

In order to arrive at an independent estimate of cement consumption, an exercise was carried out to see how the ratio of cement consumption to the GNP in a number of developed and developing countries varied over an eleven-year period for which comparative figures were available. Some interesting figures were obtained, which are shown in table 16.

Table 15. Consumption of paper
(Thousands of tons)

Estimating body	1966	1967	1968	1969	1970	1971	1972	1973	1974	1975	1976	1977	1978	1979	1980
Sandwell	48.4	53.2	87.2	105.7	140.2		180	196		295					420
University of Indonesia	49.4	75.6	105.7	96.1	148.7	156.9	145	150	160	170					
Indonesian Pulp and Paper Assoc.		70.5	85.2	103.2	127.5	137.9	177	200							
World Bank	54.6	76.3	99.2	104.3	134.5										
Dittmer	52.8	76.9	90.3	110.5	164.2	177.0	199	222	246	273			300		500
Asian Industrial Development Council												23[illegible]			
Directorate General of Chemical Industries						181	188	271		282	323	364	425		
						← Actual →				← Second National Five-Year Plan →					
Mean	51.3	70.5	93.5	104.0	143.0										

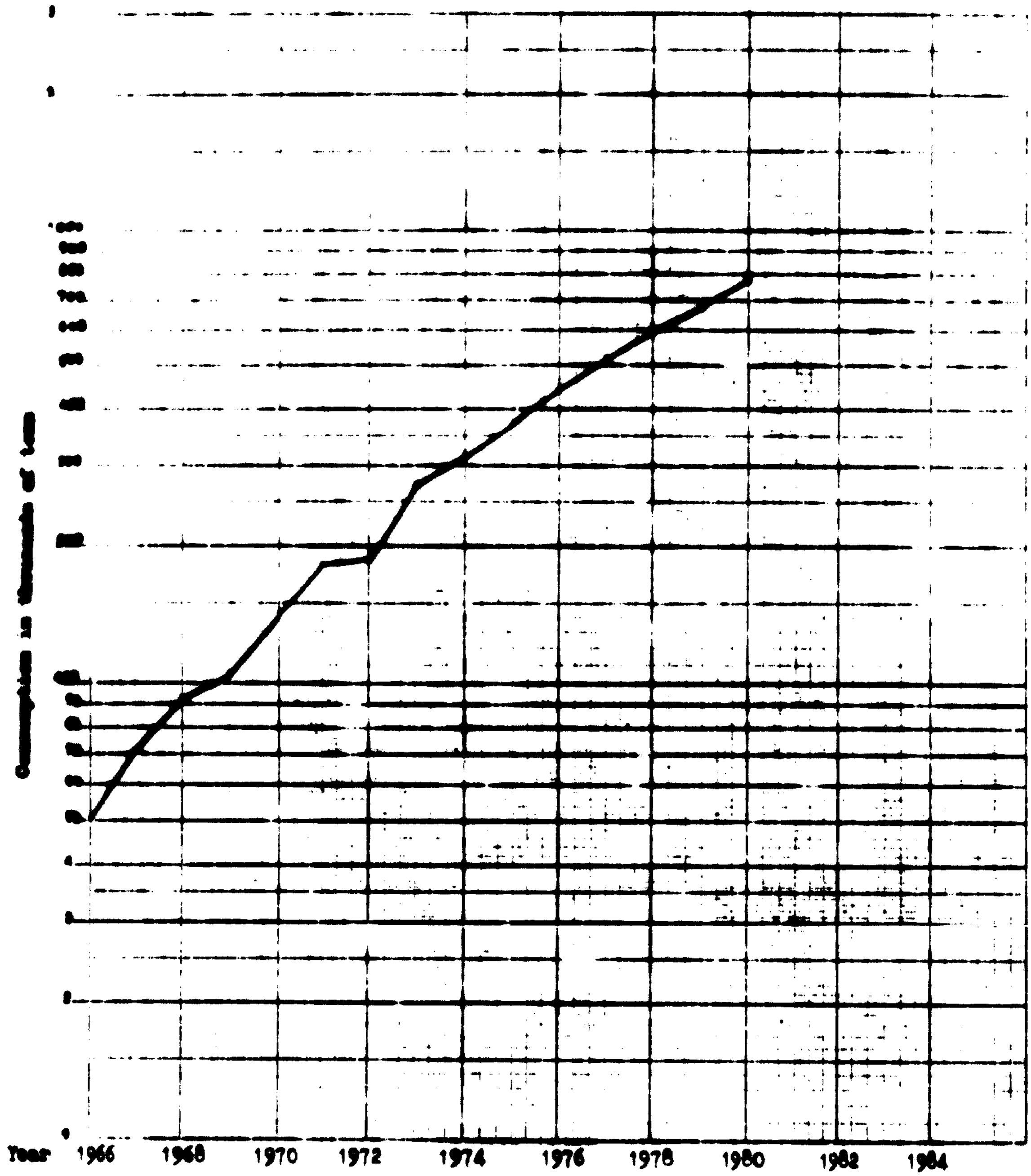

Figure I. Consumption of paper (projection technique)

Table 16. Ratio of cement consumption to GNP, 1960-1971
(Kilogramms per dollar at current prices)

	1960	1965	1967	1969	1971
Argentina	0.150	0.132	0.165	0.162	0.190
Australia	0.135	0.146	0.300	0.287	0.132
Bolivia	0.084	0.096	0.123	0.163	0.137
Brasil	0.183	0.202	0.196	0.190	0.224
Indonesia	0.072	0.1075	0.050	0.080	0.150
Japan	0.290	0.265	0.401	0.333	0.425
Malaysia	0.191	0.287	0.290	0.264	0.258
Thailand	0.128	0.244	0.462	0.427	0.343
Turkey	0.308	0.460	0.460	0.499	0.525
United Kingdom	0.126	0.142	0.188	0.167	0.132
United States	0.080	0.070	0.089	0.078	0.066
Uruguay	0.139	0.292	0.243	0.233	0.177

No clear trend emerges from these figures. If anything, cement consumption expressed as a decimal fraction of the GNP seems to reach a maximum in 1967 and then fall off. It is clear, however, that cement supplies a much smaller part of the GNP in the traditionally developed countries. The emerging countries like Japan, Thailand and Turkey have a much higher consumption of cement in relation to GNP. The most obvious conclusion from this is that they use a much higher proportion of cement compared to other construction materials while they are engaged in building up their infrastructures (roads, bridges etc.). Indonesia has an exceptionally low ratio, even for a very low GNP. It is probably safe to assume therefore that cement consumption will grow much faster than the GNP and reach a ratio of 0.20 by 1975 and 0.25 by 1980.

Great care must be taken to avoid the effect of inflation. If the 1974 GNP *per capita* is taken as $100 and an inflation-free increase of 5 per cent per year is assumed in the GNP *per capita*, the figure in 1975 will be $105 and in 1980 $134. An inflation-free growth rate must be taken in comparing a weight of cement against a value figure. On this basis, the consumption *per capita* of cement in Indonesia would be 21 kg in 1975 and 33.5 kg in

1980. Or, on the assumption of a 2 per cent increase in the population (129.7 million in 1975 and 143.2 million in 1980) the total consumption would be 2.7 million tons in 1975 and 4.9 million tons in 1980.

By graphical methods, that is by plotting cement consumption against year and projecting, the following figures are obtained for 1975 and 1980 (see figure II):

	Not less than	Not more than
1975 consumption	2,100,000	2,250,000
1980 consumption	3,350,000	4,400,000

These are both partly subjective estimates. The University of Indonesia estimates are as follows:

	Low estimate	High estimate
1975 consumption	2,079,000	2,251,000
1980 consumption	3,661,000	4,337,000

Here, the low estimate is based on a GNP growth of 13 per cent and the high on a growth of 15.5 per cent. These percentages include the inflation factor and in view of world inflationary trends the actual GNP figures have little meaning today.

The graphical estimate and the University estimate are quite independent of one another, yet, except on the lower estimate in 1980, they show remarkable agreement.

The forecasted demand given in Plan II report is 2,200,000 tons for 1974/75 and 2,660,000 tons for 1975/76, from which it can be estimated that the demand for 1975 would be 2,400,000 tons while that for 1978/79 is given as 4,395,000 tons.

While these are not higher than the figures obtained from the GNP/consumption ratio, the latter estimate, though independent, is very subjective. As the projection method and the University estimates show such close agreement, it is recommended that the official estimates be shaded down slightly: 2,150,000 tons for 1974/75; 2,500,000 for 1975/76; 2,950,000 for 1976/77; 3,500,000 for 1977/78; and 4,000,000 for 1978/79.

<u>Nitrogen fertilisers</u>

The demand for nitrogen in Indonesia has been estimated by many authorities and consultants. The comparative figures are set out in table 17.

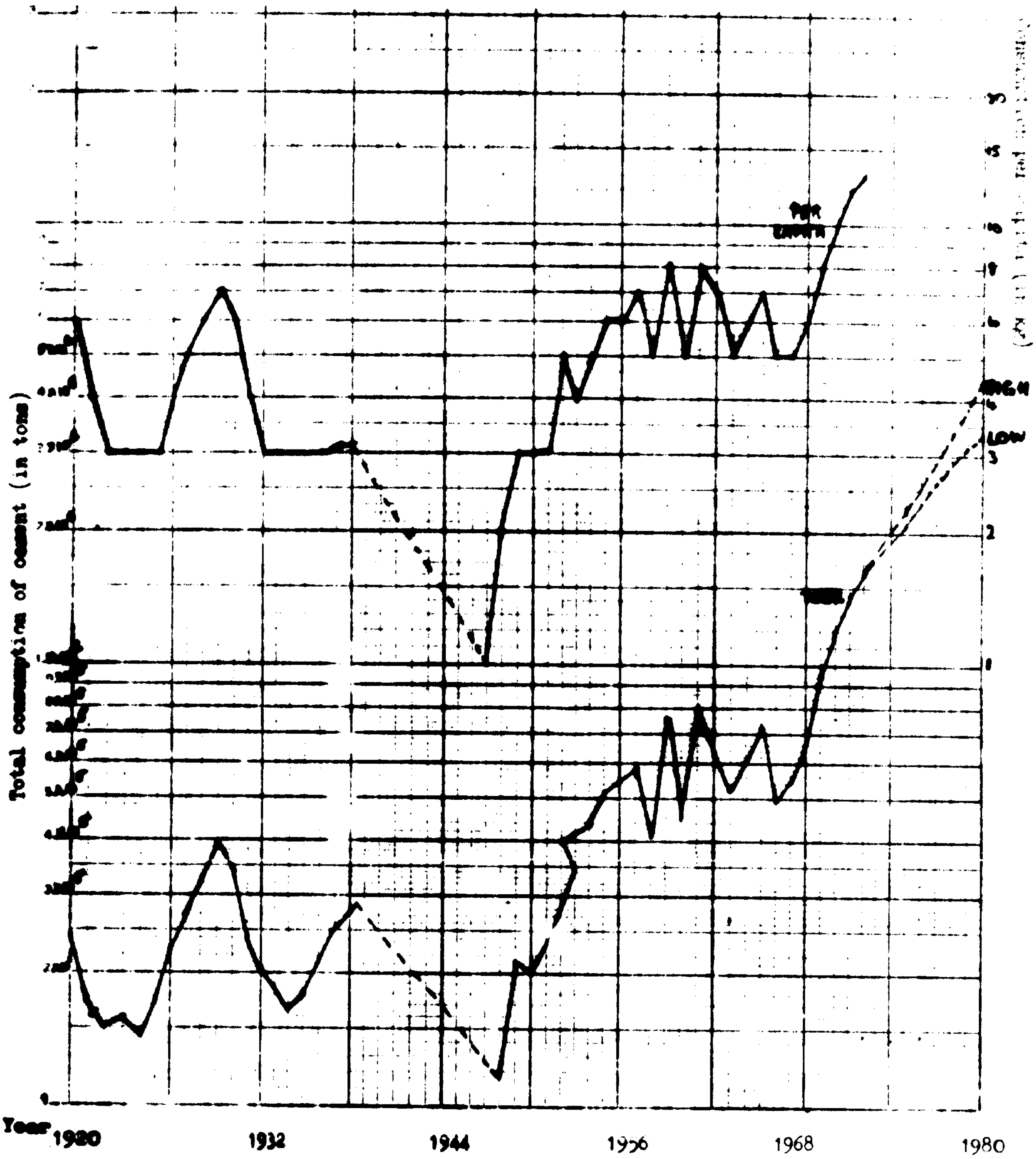

Figure II. Consumption of cement

Table 17. Consumption of N
(Thousands of tons)

	Stangel's First Report	National Fertiliser Study	Kemmler Report	Stangel's Second Report	
				Maximum	Minimum
1964	108	83			
1965	90	93			
1966	96	98.5			
1967	67	104.9			
1968	101	186.4			
1969	171	141			
1970	184	165	219		
1971	197	194	260		
1972	241	227	-		
1973	285	266	372		
1974	350	311		396	370
1975	420	345	440	440	404
1976	440	383		484	437
1977	462	425		528	471
1978	508	472		571	506
1979	608	523		613	541
1980	668	562	700	655	576

The figures from Stangel's First Report and the National Fertiliser Study were averaged, graphed on semilog paper and projected. This gave maximum and minimum figures for 1975 of 350,000 and 335,000 tons respectively while the corresponding demand for 1980 was 680,000 and 600,000. These figures would seem, compared with other forecasts, to be low in 1975 and high in 1980.

There is a major difference in fertiliser estimates by the amount actually used and the amount "required" for the optimum results, and this needs to be thoroughly understood. Normally, when estimating a demand, free availability is assumed; if the availability is restricted, conventional methods of estimating consumption are useless. Consumption, use and demand are assumed to mean the same thing here, but "requirements" are taken to mean the quantity required to give the optimum results on the soil concerned; the farmers will not necessarily buy the quantity, what they will buy is here called consumption (demand) use. The amount "required" for optimum results is given in the Plan II report as shown in table 18.

Table 18. "Required" nitrogen fertilizers
(Tons)

	N as urea	N as ammonium sulphate	N as compounds	Total N
1974	5[illegible],[illegible]4[illegible]	35,490	9,610	555,520
1975	637,540	36,960	10,995	686,575
1976	714,940	39,270	14,370	[illegible]81,88[illegible]
1977	825,240	41,370	18,745	88[illegible],1[illegible]5
1978	908,500	43,100	24,255	976,79[illegible]

The percentage of N actually used to the amount required on these estimates (the average of the maximum and minimum on the projected figures is taken as the use demand) decreases from 57 to 55 between 1974 and 1978. Since the amount (at any rate of urea) to be produced will exceed the use demand before the end of Plan II, it would seem that every effort should be made to push up this percentage by good salesmanship, making sure the fertilizer is there at the right time and training farmers to get the best from their land with maximum food production. If this is done, it is considered that the use/demand should reach at least 700,000 tons by the end of Plan II and probably 8[illegible],000 tons by 1980. Of this figure, some 50,000 tons of N are likely to be in the form of ammonium sulphate, 40,000 tons compound, and the remainder urea. (See figure III.)

Phosphates

Since all P_2O_5 has to be imported, supplies are seldom available when they might be most useful. Production is still at the planning stage; the half-erected single superphosphate plant at Cilacap has been abandoned, but studies in depth are being carried out on the production of triple phosphate and some compounds from imported phosphoric acid at Gresik. It appears however that supply will fall far short of demand well into Plan III. It has been recommended that Gresik production be substantially increased, but in the immediate future demand is likely to be conditioned by availability.

The National Fertiliser Study estimates consumption to have been 52,000 tons of P_2O_5 in 1969 rising to 128,000 tons in 1974; 169,000 in 1976 and 296,000

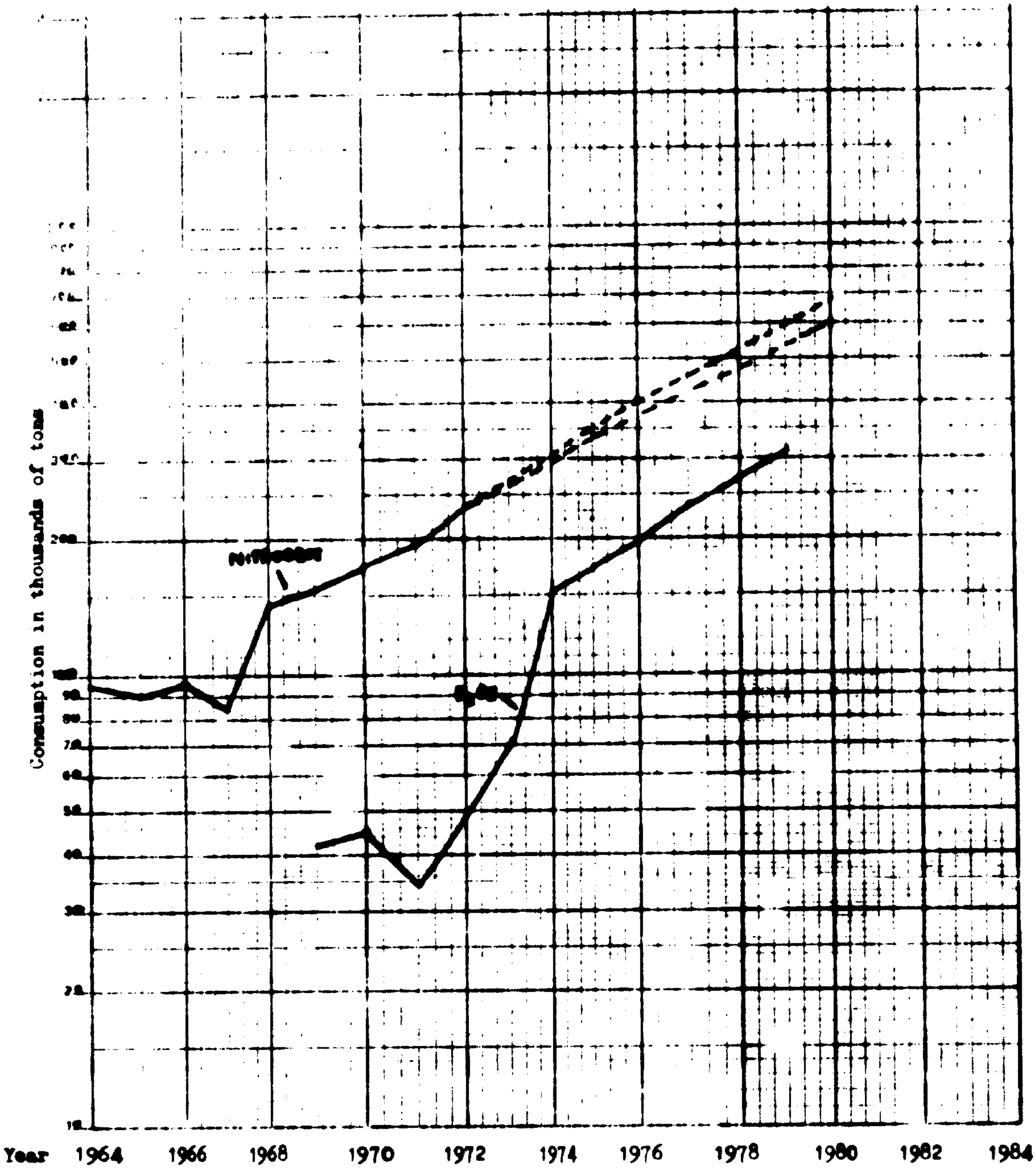

Figure III. Nitrogen and phosphate consumption forecast in 1980. Kemmler estimates 210,000 in 1974 and 350,000 in 1980. As there is little need for phosphates in paddy fields, a significant proportion of the consumption is accounted for by upland rice and other food crops and estates.

Figures now issued by the Ministry of Agriculture and quoted in reports to the Meeting of Asian Experts on Fertilizers and Pesticides held recently in Jakarta are somewhat peculiar. Allowing 15 per cent P_2O_5 in compounds and 15 per cent in "other fertilizers" (this being no more than an intelligent guess) consumption is given as follows (in thousands of tons):

	Consumption		Consumption
1969	42.8	1974	204
1970	45.4	1975	220
1971	34.9	1976	271
1972	33.2	1977	293
1973	71.5	1978	324

The break between 1973 and 1974 is so great it seems probable that later figures refer to requirements rather than actual demand, as mentioned under N. The statistics for probable actual demand are likely to be as follows (in thousands of tons):

	Demand		Demand
1974	152	1978	272
1975	172	1979	313
1976	197	1980	356
1977	235		

Those figures are based on plotting the National Fertiliser Survey forecasts and adding on to them components for the P_2O_5 in compounds and in other fertilizers which do not appear to have been included.

However, until P_2O_5 is produced in Indonesia, consumption can only be related to imports. While these are (at any rate partly) controlled, consumption can be controlled. Estimates of consumption are therefore hardly relevant; the requirement figures are more meaningful. Nevertheless, whichever set of figures is taken, consumption or requirements will be far ahead of current planned capacity and this should be given careful consideration.

Potassium

Indonesia imports its potassium and will continue to do so for some time. Consumption is controlled by the amount imported. The figures put forward for consumption and future demand (probably the same as requirements) at the Meeting of Asian Experts on Fertilizers and Pesiticides and set against the National Fertiliser Survey figures are shown in table 19.

Table 19. Potassium consumption
(Thousands of tons)

	Meeting of Asian Experts on Fertilisers and Pesticides	National Fertilizer Study
1969	13.7	26
1970	18.2	32
1971	6.7	40
1972	39.5	50
1973	17.0	63
1974	33.0	79
1975	44.0	89
1976	58.0	101
1977	81.0	115
1978	107.0	131
1979	-	148
1980	-	168

In all estimates of fertiliser consumption and production the effect of the subsidy plays a great part. At present urea, TSP and 15-15-15 compound are subsidised for food crops only. The subsidy can reduce the free market price of fertilisers by as much as a third. Any variation in the subsidy, either up or down, can have a major effect on the demand. This is under the Government's control.

Plastics

Here, unlike fertilisers, there is no question of a subsidy. Imports are private and the demand for raw materials is based purely on commercial development. A vital question is: how much will the increase in crude oil prices raise the price of plastics raw materials, and how far will this affect the demand?

As a very rough estimate, a five-fold increase in crude oil prices will boost the cost of raw materials by 50 per cent, rather more for polyethylene and rather less for PVC.

Between June 1972 and June 1974, oil prices in Indonesia increased from $1.97 to $11.76 per barrel, an increase slightly under six-fold. Japanese average ex-factory prices for PP, PVC and PE in United States dollars/kg (all calculated at [illegible] to the dollar) have increased by about 48 per cent (changes in the rate of exchange mean this is very approximate). United Kingdom prices, using the index of wholesale prices for plastics and resins, have increased by 56 per cent over the same period (but this includes high-cost sophisticated materials which are less immediately affected by an increase in oil prices).

ICI (United Kingdom) made some calculations on the effect of the increase in oil prices; their conclusions are shown in figure IV.

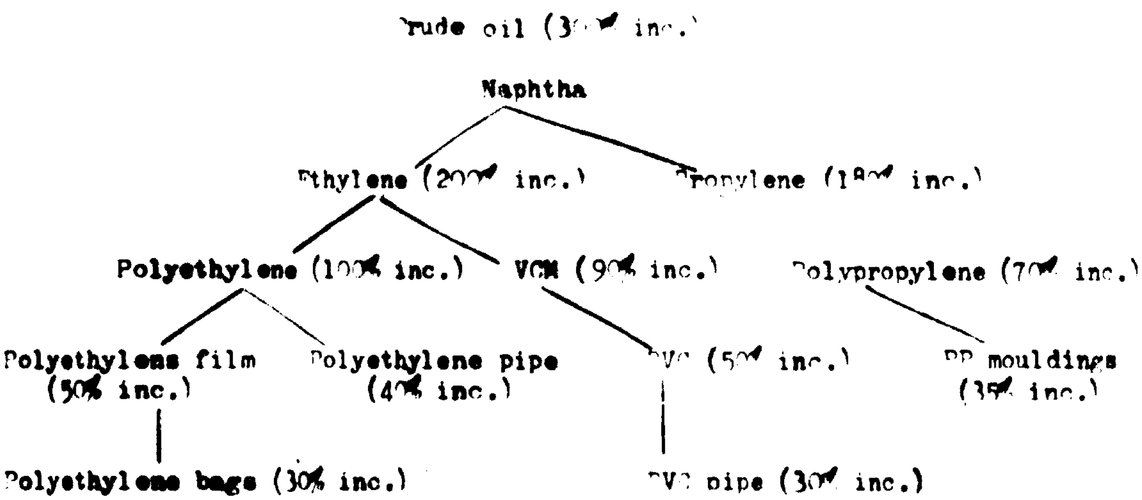

Figure IV. Effect of oil price increases on plastics manufacture

ICI also calculated the quantity of crude oil-equivalent, in terms of calorific value, which would be required to provide the energy of conversion and, where appropriate, the feedstock, for a number of base chemicals. The figures were given in terms of Kcal x 10^6 per ton but as volume rather than weight is often the important parameter they have been recalculated in terms of volumes. The figures are shown in table 20.

Table 20. Crude-oil-equivalent required for conversion energy or feedstock

	Density gm/cm³	Kcal x 10³ per ton	Kcal x 10³ per m³
Aluminium	2.7	58	158
Steel billet	7.8	10.5	82
Tin plate	7.8	13	102
Copper billet	8.9	12.5	112
Glass bottles	2.4	4.5	11
Paper and board	0.8	15	12
Cellulose film	1.45	48	70
Polystyrene	1.07	33.5	36
PVC	1.38	20	28
LD polyethylene	0.92	24	22
HD polyethylene	0.96	25	24
Polypropylene	0.90	27	24
Cement	2.20	1.95	4.3

The distribution between the oil needed as feedstock and as fuel was also given and is shown in table 21.

Table 21. Crude oil-equivalent as feedstock and as fuel (Percentage)

	Oil-equivalent as feedstock	Oil-equivalent as fuel
Polystyrene	41	59
PVC	28	72
LDPE	49	51
HDPE	48.5	51.5
Polypropylene	46	54

The high proportion of fuel in the case of PVC is reflected in the power necessary for the electrolysis of the salt to produce the chlorine.

To see how prices have increased for various products competitive to plastics in the United Kingdom (no other up-to-date figures were available) the wholesale price indices were used once more, with the results shown in table 22.

Table 22. Price increases in products competitive to plastics

	Percentage increase, Jan. 1970–July 1973	Percentage increase, July 1973–July 1974
Plastics raw materials	1.5	52.7
Tin plate	8.1	47.8
Rolled aluminium	4.4	22.5
Cement	7.7	25.6
Paper board	5.3	49.2
Glass	16.4	20.7
Foot-wear leather	14.0	- 1.2

From table 22 it seems that glass and leather may become more competitive. The replacement of glass bottles by plastic bottles might therefore fall off and plastics might intrude less into the production of shoes or leather cloth than it might have done had the oil price increases not taken place. Comparative prices for wood could not be contained on the same basis, but in countries with a plentiful supply of timber, and this includes Indonesia, plastics are unlikely to compete with wood, as matters stand at present.

The Japanese Gasoline Co. recently carried out a survey of petrochemicals in Indonesia, including plastics, and Unico in an even more recent survey adapted their market estimates. They confined themselves to the major thermoplastics and estimated the figures for raw materials shown in table 23.

Table 23. Growth rate of petrochemicals, including plastics

	1968	1969	1970	1971	1972	1975	1978	1980	Rate of growth, 1972–1980 (percentage)
LDPE	12	17	18	22	26	36	63	90	16.8
HDPE	1	2.4	3.9	6.4	9	11.5	16	20	13.7
PVC resin	9.5	11.3	16.3	19	25	38	59	80	15.6
PP	-	0.5	1	4.5	8	17.5	36.5	60	28.6
PS	1.9	2.8	3	3.5	4.6	9	16.5	25	23.6
Total	24.4	34.0	42.2	55.4	72.6	112.0	191.0	275	
Average									18.1

Until 1972, Indonesian import statistics were based on a very old classification and figures for plastics, including raw materials, were only divided between cellulose and plastics material for moulding purposes (except cellophane) and plastics-moulded articles.

These did not offer much scope and most of the information on the earlier years was based on exports from other countries, particularly from Japan to Indonesia. In 1973, for the first time, the import statistics were based on the Brussels Tariff Nomenclature, but were still not divided between different plastics raw materials other than between condensation, polymerization, cellulose and other products. Figures for these were 2,800 tons, 103,750 tons, 16,8[illegible] tons and 14,50[illegible] tons respectively. The "other products 39.4" group was intended by those who drew up the Brussels Tariff Nomenclature to be very small and restricted to a few items such as vegetable-based plastics, but it was used by importers to "dump" plastic products they could not otherwise classify. It seemed reasonable to assume that at least half of these belonged in the thermoplastics (polymerization) group, making a total of (say) 111,000 tons which, according to the Japanese Gasoline Co. estimates, would only be reached by 1975.

This was then taken as a new basis and the rate of growth for the next seven years considered. Long-term estimates made by Rönitz of Hoechst had indicated an over-all increase in the consumption of plastics (not just plastics raw materials) of 16 per cent per annum in developing countries between 1970 and 198[illegible] (this, like the Japanese Gasoline Co. estimates, was made before the oil price increases). An estimate of the consumption of the principal thermoplastics in a number of countries in 1971 was made (1971 being the latest year for which comparative figures were available) and an arbitrary 1[illegible] per cent added to the consumption figures to cover plastics products incorporated in other goods such as cars, transformers, radio and television sets, ships, railway coaches and aircraft. (See table 24.

Indonesia is far behind. In other words, the use of plastics is less for the general standard of life than it is in other countries. The Rönitz standard is 16 per cent per annum for all developing countries; in "normal" circumstances an increase of 20 per cent per annum would be recommended for Indonesia, but in view of the possible reduced rate of penetration vis-à-vis leather and glass, 15 per cent might be a more realistic figure.

Table 24. Consumption of principal thermoplastics (not just raw materials) and comparison with GNP

	Plastics consumption (kg *per capita*)	GNP (dollars *per capita*)	Ratio plastics consumption to GNP (per cent)
Japan	30.9	2,130	1.45
Thailand	2.3	210	1.09
South Korea	3.3	264	1.25
Malaysia	1.92	400	0.49
Philippines	2.55	228	1.12
Indonesia	0.54	80	0.60

Taking 110,000 tons as the consumption figure for the principal thermoplastics in 1973 (this includes the addition of a percentage for plastics not covered in classification 39 and the deduction of a similar percentage for polymerisation products not included in "principal" thermoplastics such as polymethyl methacrytate vinyl acetate etc.) the following totals are obtained for the succeeding years:

	Tons		Tons
1973	110,000	1977	211,000
1974	129,000	1978	248,000
1975	152,000	1979	293,000
1976	179,000	1980	346,000

The Japanese Gasoline Co. survey estimates for the percentage break-down of consumption between the various thermoplastics in 1980 in a number of countries are given in table 25.

Table 25. Forecast consumption of various thermoplastics in selected countries in 1980 (Percentage)

	India	Iran	Japan	Korea	Malaysia
LDPE	34.5	32	19.3	30.8	30.1
HDPE	10.5	13.2	12.0	18.4	14.0
PVC	27.4	40.6	25.4	28.7	24.7
PS	23.6	10.2	30.0	10.2	21.0
PP	4.0	4.0	13.0	13.8	10.2

The figures vary considerably. Taking into account the present economic situation, the following break-down is suggested for 1980 in Indonesia:

	Per cent	Actual quantity (Tons)
LDPE	32	110,000
HDPE	12	41,000
PVC	30	104,000
PS	10	35,000
PP	16	55,000
		345,000

For this to be achieved:

(a) Sufficient processing equipment must be available, and the companies organized to take advantage of it. This means that the Directorate General of Light Industries must be persuaded to reverse its present policy that new entrants to the plastics processing industry will only be permitted under exceptional circumstances;

(b) Equipment manufacturing facilities must be set up, with emphasis on tools, moulds, and dies (Directorate General of Basic Industries);

(c) Sufficient technicians must be trained to control the equipment and personnel to operate it;

(d) A vigorous marketing policy must be drawn up by a trade association established by the Directorate General of Light Industries to exploit new end-use possibilities and to convince potential customers of the value of plastics for appropriate applications;

(e) The possibility of exporting finished products should not be overlooked. Such products enter most European countries duty-free; Indonesia should have just as good an opportunity to promote this sort of trade as Hong Kong or Singapore. The lower costs should prove an advantage;

(f) Implementation of the above could be considerably accelerated if a plastics centre were set up.

IV. NEW FEASIBILITY STUDIES AND SURVEYS RECOMMENDED (TO BE CARRIED OUT WITH OUTSIDE ASSISTANCE)

Surveys recommended

In-depth study on the production of chlorine

A decision on the Asahan Dam will come too late to be taken into account in this report. Now, who is planning production in the Aceh region, indicates that electricity produced by water could be as little as one tenth the price of that produced from petroleum fuels at current costs. In view of this, an independent investigation of the best location for chlorine-caustic soda production would seem in the national interest.

Study on the production and demand for dyestuffs and organic pigments

These are used in textiles, plastics, paper, inks, and sometimes even paints. Production is labour-intensive and with the ample quantities of benzene expected to be available in a few years time, production in Indonesia will become attractive. (See also chapter I.)

In-depth study on the production and use of nitric acid

Nitric acid is a basic material for a wide range of chemical production. It is produced by the oxidation of ammonia. (Ammonium nitrate is an excellent fertiliser.) Supplies of methane from "associated" natural gas sources are ample; these are now being flared and could be used to produce the additional ammonia. (See also chapter I.)

In-depth study on the production and use of methanol

Methanol is required for the production of formaldehyde; for the production of DMT; and as a solvent in many reactions. It has been proposed converting natural gas (methane) to methanol, for easy transport, and using it as a fuel.

A blend of (say) 10 per cent methanol in gasoline is worth considering as a replacement for TEL; many of the disadvantages of such a blend in temperate climates do not apply in tropical climates; there may even be advantages.

Again, raw materials are freely available. (See also chapter I.)

Study on the production of catalysts from the mineral resources of Indonesia

Nickel, manganese, tin and molybdenum are available in Indonesia. Catalysts production is a very specialized art and would need the co-operation of a company with the proper techniques. It is, however, labour-intensive and the products, being very high in value on a weight basis, are suitable for export over large distances.

The development of petroleum refining and petrochemical production in Indonesia would provide a substantial local market too.

Perum Petrokimia development

As mentioned in chapter I, a study in depth should cover:

(a) The production of phosphoric acid from imported phosphate rock by treatment with sulphuric acid, which also yields calcium sulphate;

(b) The production of TSP by the reaction of phosphoric acid with more phosphate rock;

(c) The reaction of phosphoric acid with caustic soda (or soda ash) to give sodium tripolyphosphate for detergent "building";

(d) The reaction of the calcium sulphate produced in (a) with ammonia and carbon dioxide to give ammonium sulphate without the use of sulphuric acid;

(e) The production of soda ash by the "dual process" which allows smaller plants to operate more economically than with the ammonia soda process and which produces ammonium chloride as a by-product;

(f) The use of ammonium chloride as a fertiliser. One authority recommends it as specially suitable for paddy; another states it is unsuitable for Indonesian soil. Further investigation is needed. This, though related to the over-all survey, would probably have to be conducted separately, by different personnel.

If no action is taken on this composite recommendation for Perum Petrokimia, it is proposed that an entirely separate feasibility study be carried out on the production of sodium tripolyphosphate for detergents, which would appear justified on its merits.

Carboxylic acids

A market survey should be carried out of the demand for carboxylic acids followed by a production feasibility study should the demand for any one or any group justify it.

UV absorbers

A feasibility study on the production of organic nickel UV absorbers for plastics, particularly polypropylene and organo tin antioxidants for PVC etc., is advised. The idea is that the absorbers would be produced from local mineral deposits combined with organic chemicals derived from the petrochemical activities. Since plastics, particularly in hot climates, may require quantities of the order of 0.5-1 per cent of the plastic raw materials, it is clear that quantities of 500-1,000 tons in the not too distant future would be required.

Organochemical complex

A feasibility study should be carried out on an organochemical complex in the South Sumatra area.

DDT

The feasibility of the production and formulation as 75 per cent wettable powder of DDT for malaria control and eradication is worth studying. The malariologist considers that 3,000-4,000 t/a of DDT will be required for the next five years for this purpose. After that, it will depend upon the funds available. Malathion would be preferred to DDT, but at the moment it is far too expensive.

Phenoxyacetic acids

The feasibility of the production and formulation of 2,4-D and MCPA herbicides should be examined. These are relatively simple chemical products and several private companies are looking at the production possibilities. It would be clearly in the interest of the Government to have an independent assessment made.

Organic phosphorus insecticides

A prefeasibility study should be carried out on the production of organic phosphorus insecticides. This, in the long term, may be of great importance. Many companies are formulating these insecticides but do not want to produce them. Local production of the base concentrates would be most valuable. Diasinon is one of the most favoured insecticides, production of which would be particularly welcomed; malathion is an acceptable alternative to DDT.

General use of surveys and feasibility studies

Too many surveys and feasibility study reports end up gathering dust on the shelves of government offices. Authors of surveys should be told that their investigations, if positive, will be used to advertise Indonesia to the world. Since the Government will only rarely want to take positive action itself, relying rather on private enterprises, the surveys should be circulated to all major companies in the world that are accustomed to making the particular product and that are not already represented in Indonesia with the suggestion that they consider investing in the country. In this way, the surveys will be of far more value to Indonesia than if they remain on the shelves. It is appreciated that the Government sometimes wants a survey of some aspect of the chemical industry solely for its own use, in which case general distribution would not be carried out.

V. PLANNING AND CARRYING OUT TECHNOECONOMIC FEASIBILITY STUDIES

This short chapter discusses some of the problems that arise in planning and carrying out feasibility studies, both major and minor.

A careful examination of the more voluminous study reports shows a great deal of repetition; they could, in most cases, be reduced to one third or one quarter of their length without losing anything of importance. This is particularly true of reports prepared by consulting companies, the staff of which are drilled into believing they are not giving their client his money's worth unless the survey is of a certain length. The senior official who has authorized the survey but does not intend to read it in detail is impressed by the length; he turns it over to his subordinates who glance through it and, unless it is of major importance to a project on hand, put it on a shelf alongside a host of similar surveys.

This should be pointed out to any organization which is about to prepare surveys. Also, the importance should be stressed of providing a brief summary (some surveys do) that can be read in 20 minutes so that anyone studying it can size up in a short time whether the survey is of any interest to him in his work.

Effect of inflation

Many petrochemical and fertilizer surveys, particularly recent ones, have been overtaken by events. The enormous increase in oil prices and the world inflation have meant that financial prognostications are virtually valueless and that discounted cash flow returns have only comparative significance. It is essential that in future surveys some guidance be issued to the authors as to how these factors should be treated. The Unico survey discussed in chapter III tried to grapple with this by taking the end of Janurary 1974 price of crude oil as a base and then assuming a 7 per cent increase per annum and, in addition, treating all prices and costs to an inflationary factor of 7 per cent per year. But even this is reckoned to be out of date now. No one can predict the outcome of the present inflationary trends. The implication of this are too tremendous to grapple with in this report.

It is important, however, that agreement be reached with the authors of the survey as to how this problem is to be dealt with. Is it not possible that unknown variables such as the rate of inflation or the price of oil (or other raw material) could be denoted by algebraical symbols, examples being given for actual values of costs and returns but the recipients being left to fill in the precise values in force at the time the survey is to be used? Further, it is a waste of time to commission a survey on a project unless the raw materials to be used and the place where they will be available can be specified. The only exception is where the object of the survey is to recommend the source of material that it is most advantageous to use.

Interest

The "cost" of loans needs careful consideration. If capital can be borrowed at 10 per cent while inflation is at 15 per cent a great many processes will prove profitable as repayment of the loan is at a fixed rate while the price obtained for the product, and hence the trading profit, is steadily increasing. How the capital cost is to be allocated must be specified to the authors and (unless the object of the exercise is to find out when would be the most advantageous time to erect the plant) the date for commencing erection must be stated, otherwise it is impossible to forecast the capital cost.

Social benefits

Some attention should be paid to social-benefit costing. It may be desirable for the exercise to be carried out without taking this into account, but on the other hand to a country like Indonesia the results can be most meaningful. It is not easy to apply quantitative figures to social benefits, but if it is desired that the survey should include these, the figures to be adopted should be approved by the authors in advance. On the other hand, it is perfectly legitimate for the whole purpose of a survey to be to give social benefits meaningful figures, but such a survey is hardly likely to be commissioned by the Directorate General of Chemical Industries alone. Some of the items that might be specified in social-benefit costing are: (a) premiums on exports and imports to quantify the saving in foreign exchange; (b) a discount on raw material and equipment purchases in Indonesia; and (c) a premium on that part of foreign workers' remuneration that is, or is permitted to be, transferred out of the country and a discount on that spent in the country, the size of the discount being related to value of the local spending to the neighbourhood (thus, no discount or a very small discount in Jakarta but a considerable one in Aceh).

If the new plant will give employment to hitherto unemployed locals, wages can be discounted substantially in the costing as much indirect economic benefit will be brought to the area.

On the other hand, if it means that farmers who have previously grown (say) rice are going to seek work in the plant and that the rice will not be grown, then the cost of importing the deficiency of rice must be added to the annual cost of the project. The same applies if hitherto crop-bearing land is going to be lost owing to its being needed as a site for plant or auxiliary services such as a power station, roads, or even housing estates for the workers.

If skilled workers have to be taken from another factory to erect or operate the new plant, then the cost of training replacements must be added as well as a factor to cover any temporary loss of production in the factory from which the skilled workers have been taken.

Where it is desired, for social considerations, to erect a plant outside Jakarta - or outside Java for redistribution reasons - factors can be added or subtracted from the capital costs or the costs of running the plant purely because of its location and independent of, or additional to, the factors mentioned above.

It should be made quite clear that this type of costing is not going to bring about any actual transfer of money; the premium and discounts are solely used in (e.g.) calculating discounted cash flow returns to decide the most worthwhile location for a plant or even whether a project is justified at all. It is not in the same class as a tax holiday or obtaining imports free of duty, in which case the owner of the plant actually obtains a cash benefit by abiding by certain conditions.

<u>Use of computer</u>

A computer pays out only according to what is put into it, but it pays out very much more quickly than by conventional means. A faulty input will result in a faulty output, except in certain special conditions when, if the output is outside certain specified limits, the possibility of a faulty input is indicated. Computers have been well tested for data processing and for this they are ideal. In the case of a Directorate General like that for the textile industries - with thousands of small companies engaged in closely related activities and with details to be processed about each company (capital, location, number of employees, types of equipment, products made, output in quantity and value etc.) - the information can be effectively stored on a computer.

Thus, if the total value of a particular kind of cloth that, for example, requires bleaching chemicals and that is produced in West Java is required, the information can be obtained in a few moments. But, if the programmer has made an error and put the wrong code against one of the companies, indicating that it is located in Central Java instead of in West Java, the computer will not indicate the fault. That is what is meant when it is stated that the output is controlled by the accuracy of the input. (Actually, computers can be made to do a little more than this; a condition could be imposed to the effect that if the value of the output was more than (say) five times the capital a signal would be given, and the data re-examined. This can be extended to a number of other variables.)

This information will be of limited use to the Directorate General of the Chemical Industries at present as the number of companies engaged in similar production in no case exceeds half a dozen; often it is only one or perhaps two in a given field in which case records can be much better maintained by hand.

A simple form of computer is very useful when large numbers of discounted cash flow calculations are required. To do this by hand, even with discount tables, is very tedious as the rate of return has to be found by trial and error or by making five or six separate sets of figures for inputs and outputs, plotting them and finding where the resulting curves cross. A program can be set up which enables the correct rate of return to be determined in a few minutes.

Another valuable use of a computer is in deciding the most viable production from a given raw material, for example, if a certain quantity of naphtha for cracking is offered at a given price and it is desired to find out how to use it most profitably.

An enormous number of independent variables can be obtained on different ratios of ethylene, propylene and C_4 hydrocarbons by varying cracking conditions and hence the capital cost of the plant. Many different products can be made from each of the olefins. Each product will incur a further capital cost which will be less per unit produced the larger the plant. Each product will have its second-stage products and in some cases third-stage products, each with their home and foreign market at different prices. To work out the most viable combination by hand would prove a Herculean task, but a program could be set up on a computer (it might take some time) which would not only enable the desired result to be achieved, but the effect of price and demand changes, and alterations in the capital cost of certain plants could be quickly inserted into the computer and any alteration in the most viable program quickly obtained.

Critical path techniques

A number of plants in various parts of Indonesia are not operating because one factor or another has been overlooked in their establishment. In one case no raw material was available; this was a vegetable product which had to be grown in the neighbourhood of the plant and took some time to mature. In another, there was no means of bringing in the imported raw material, though the plant was otherwise ready to operate. It would be silly to claim that by using a critical path technique these difficulties would necessarily have been avoided; like a computer, it is a tool and not a panacea for all problems. It does, however, make those charged with planning and carrying out a project really think and not just get on with the easiest job first instead of giving time, thought and action to the more difficult job, which must inevitably take longer but which, until it is completed, presents the next sequence of steps in the construction of the plant. The aim should be to set down the sequence of steps - many of which must be parallel - necessary to complete an operation. The operation cannot be completed until all the steps, many of which will be interdependent, have been completed. The various stages in the operation can be connected up with arrows, each step being allocated a time factor. It will be found that one stage will be made up of a series of steps, some of which are dependent on other steps or stages being completed, and this is the critical path determining the minimum time in which the whole operation can be completed.

A very simple example is shown in figure V. It relates to the production of a key unit of a new chemical plant and shows that the critical path is the mechanical design which cannot be completed till the electrical design is completed.

A critical path diagram for the erection of a chemical plant can be exceedingly complicated and comprise a large number of uncertainties. In the simple example given in figure V, while the longest delivery date for the materials might be three months, if the supplies were behind in delivery it might easily mean

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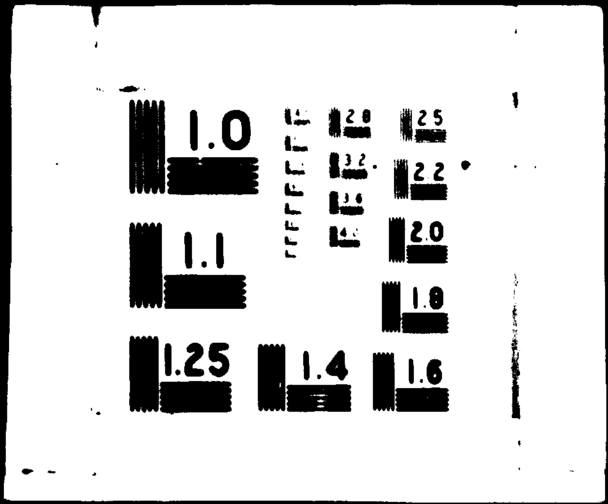

that the ordering of materials would prove to be the critical path. The degree of probability of a step being completed in the time given can be symbolized (e.g.) in the thickness of the arrows, though there are many other ways.

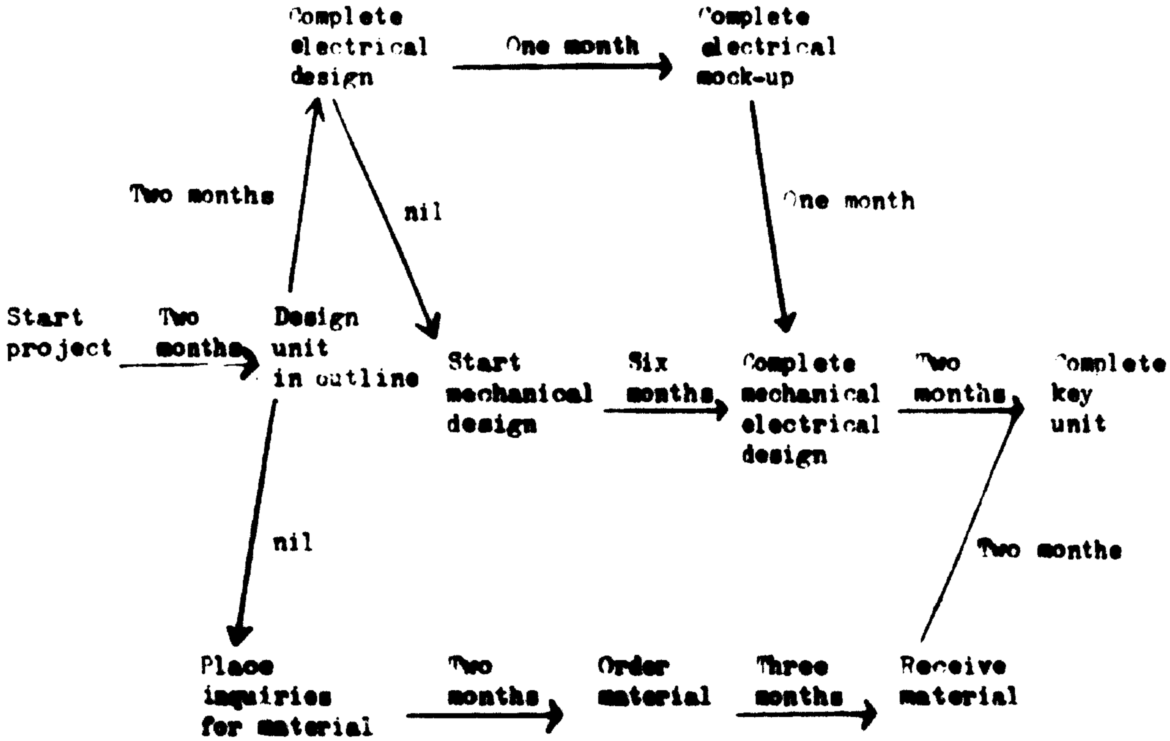

Figure V. Critical path technique applied to a chemical plant

This technique can easily be applied to the work of a government department implementating a project. Much, if not all, of the practical work is carried out by contractors, but it still may be necessary for power and water supplies, roads and (later) disposal of effluents to be arranged separately. Each of these operations will take time. The purpose of the technique is to show diagramatically the order in which they should be started so as to reach a stage of completion which would prevent a delay to the next stage.

VI. MANPOWER AND TRAINING

Manpower

The increase in the manpower used in the paper, cement, fertiliser and tire industries, together with the production of the product concerned, is shown in tables 26, 27, 28 and 29 and in figures VI and VII. The figures for 1974-1978 are estimates.

Table 26. Paper industry: manpower and output

	Employees	Output	Ratio output (tons) per man
1969	3,876	15,000	3.86
1970	4,225	19,000	4.48
1971	4,8[illegible]2	26,000	5.40
1972	4,770	35,500	7.45
1973	4,802	39,500	8.20
1974	4,604	43,600	9.40
1975	4,909	49,300	10.05
1976	6,209	72,000	11.60
1977	7,094	103,000	14.59
1978	7,794	159,000	20.20

Table 27. Cement industry: manpower and output

	Employees	Output	Ratio output (tons) per man
1969	3,512	540,000	149
1970	3,673	557,000	152
1971	3,375	548,000	163
1972	3,378	626,000	186
1973	3,008	786,000	262
1974	4,343	910,000	210
1975	4,373	1,310,000	300
1976	7,211	2,390,000	330
1977	7,970	3,744,000	470
1978	9,732	4,550,000	466

Table 28. Fertilizer industry: manpower and output

	Employees	Output	Ratio output (tons) per man
1969	1,4[illegible]	8[illegible],000	5[illegible]
1970	1,85[illegible]	93,000	5[illegible].4
1971	2,[illegible]6	1[illegible]4,1[illegible]	5[illegible].6
1972	2,133	138,000	65
1973	2,153	2[illegible]2,000	94
1974	2,[illegible]5[illegible]	336,[illegible]	161.5
1975	2,2[illegible]	549,000	249
1976	3,3[illegible]	725,000	21[illegible]
1977	4,350	1,150,[illegible]	263
1978	4,75[illegible]	2,130,000	422

Table 29. Tire industry: manpower and output

	Employees	Output (car, truck, motorcycle)	Output (tires) per man
1969	2,4[illegible]	320,000	133.5
1970	2,568	394,000	144
1971	2,568	453,000	177
1972	2,725	633,[illegible]	224
1973	2,883	1,1[illegible],[illegible]	383
1974	3,[illegible]72	1,532,000	48[illegible]
1975	3,295	2,290,000	695
1976	3,570	3,0[illegible]1,000	85[illegible]
1977	3,976	3,[illegible]01,000	873
1978	3,976	3,762,000	963

The figures are rather erratic, as might be expected when there are only a few factories; a new plant may come on stream with a full complement of workers but with little output for the first year, while a major extension on the same or a neighbouring site may need relatively few new employees but give a large increase in production.

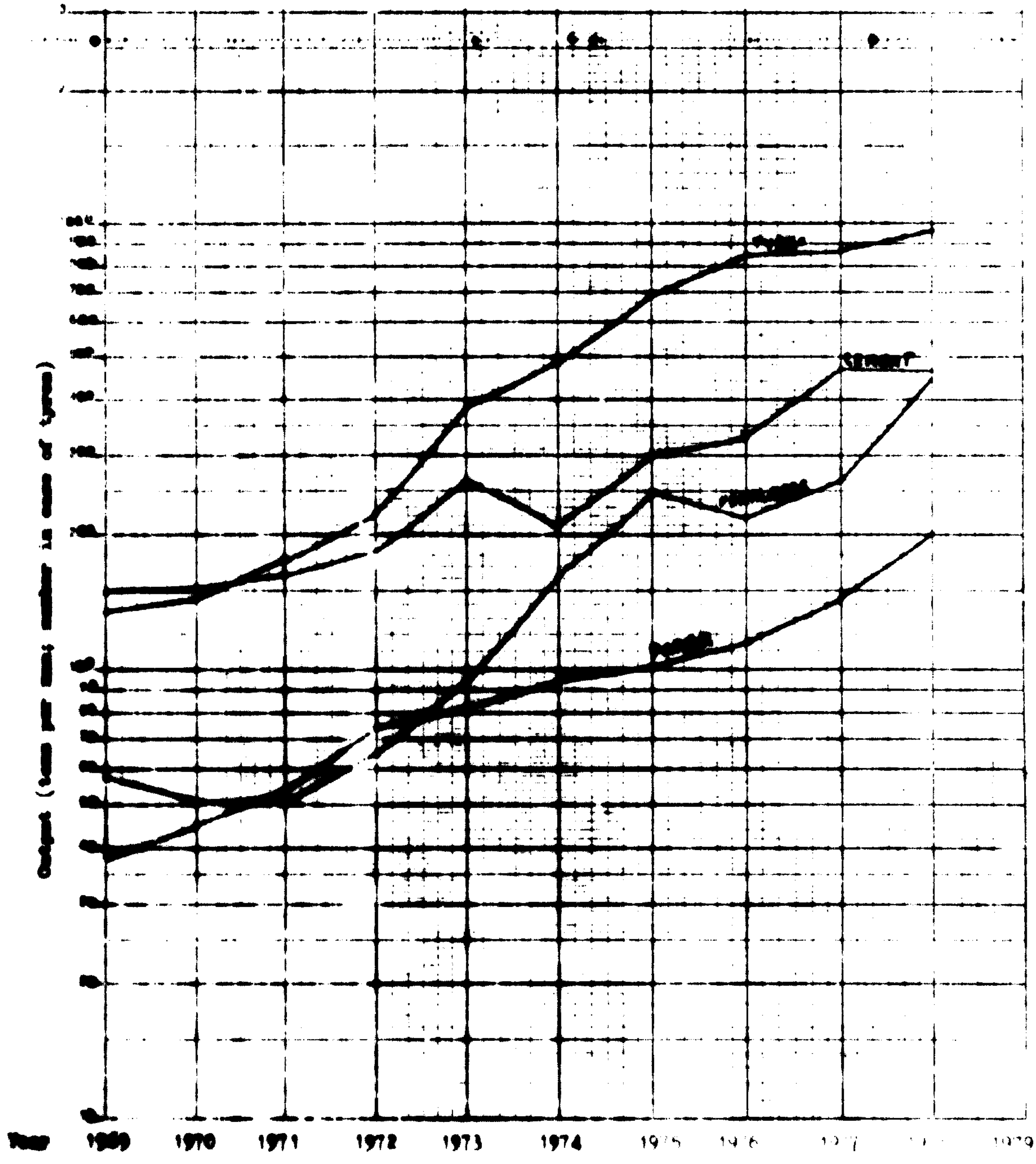

Figure VI. Change in output per man, 1969 - 1978

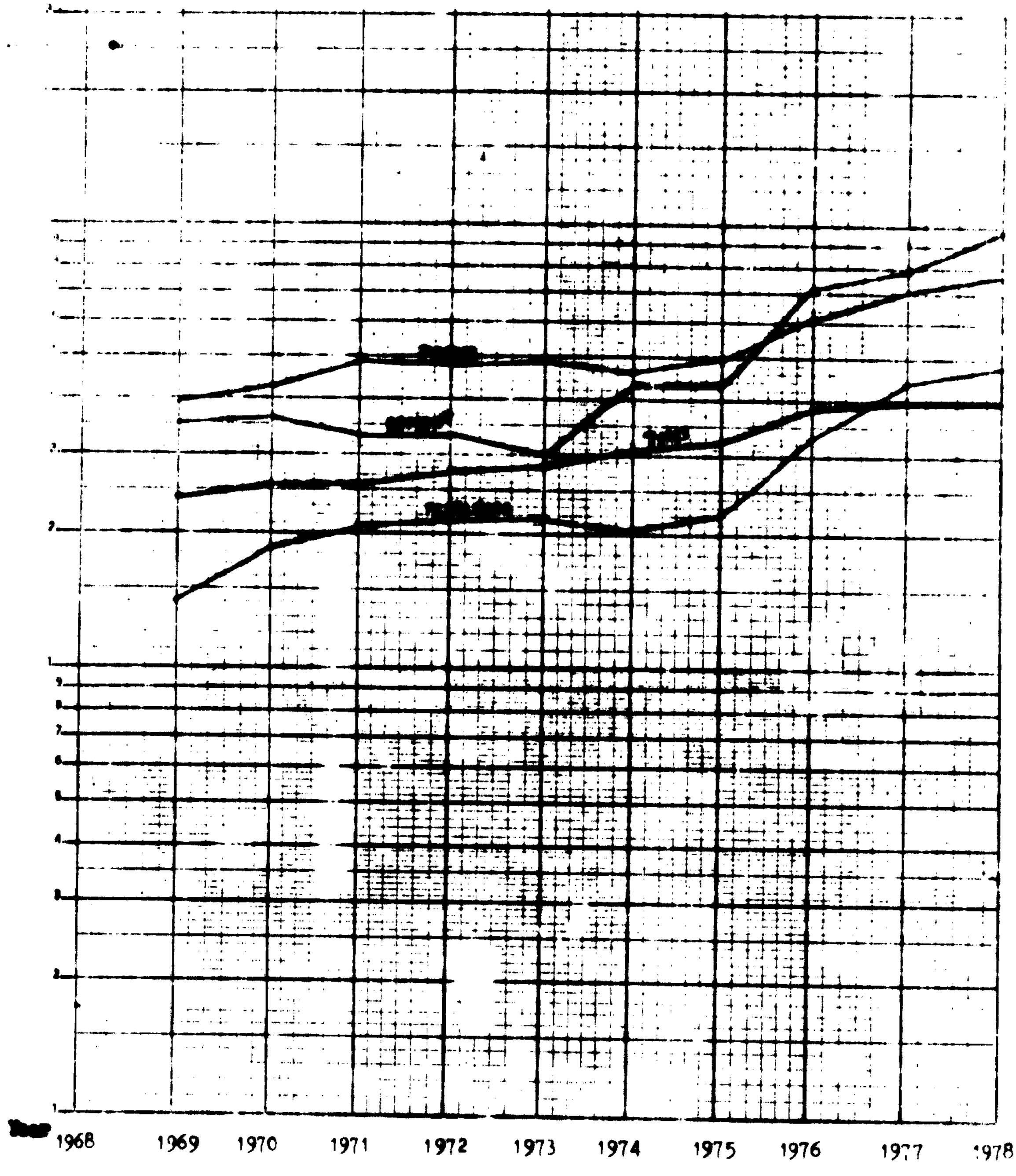

Figure VII. Change in number of employees in several industries, 1970 – 1978

It is common practice for chemical works in industrialised countries to compare their output in value per employee with output figures from their competitors, as a measure of efficiency. In Indonesia, where a very important object of industrialization is to provide employment, it would probably be correct to say that getting the maximum output from a given capital investment is more important.

The object of this exercise is, however, to forecast future demands for manpower and it is quite clear that as output goes up, even when there are a large number of small factories (as in paper), the output per man increases. An attempt has been made to plot manpower against output so that the long-term demands for labour can be estimated.

There are no data in Indonesia for a major petrochemical plant, but in the United Kingdom, a 300,000 ton ethylene cracker with propylene and butudine production and a large number of downstream plants - high- and low-density polyethylene, polypropylene, styrene and polystyrene, ethylene crude and derivatives, propylene oxide and derivatives - with attendant administration and laboratory facilities, including some for research, would employ about 4,000. This figure could probably be doubled for Indonesia at the present time.

The chemical industry is not a big employer of labour, but chemicals enter into almost every other industry. It must be thought of as a provider of raw materials for industries that are far more labour-intensive: paints, textiles, pharmaceuticals etc.

Training

The cement and paper industries are sufficiently uniform in character to justify the setting up of a training centre for operatives and technicians.

The base chemicals industry, in its present state, is not sufficiently homogeneous to plan any kind of training. The formulation of a pesticide differs so fundamentally from the manufacture of sulphuric acid - and both from the preparation of oxygen - that there is no common ground on which training can be based. A general technical education, including basic engineering and a smattering of chemistry, is suggested. Specialised training courses can then be arranged in the works, or provided by the foreign participant.

The same situation applies more or less to petrochemicals and fertilizers though here it should be made clear that the distinction between the two, in techniques, is very small. The preparation of the gas stream for making ammonia and that for making polyethylene have far more in common than ammonia and TSP production. In other words, a man trained in ammonia production could soon be adapted to another high-pressure reaction, such as polyethylene production; but to make TSP, the type of knowledge and the operations necessary are quite different.

Since Pertamina (the state oil organization) controls all petrochemical production, either wholly or in partnership, it would seem obvious that the Lemigas (Institute of Petroleum) training centre at Cepu should be adapted to train staff in petrochemical operations. (In annex II it is also proposed that it be used for training plastics technicians (not so much operatives) who would be largely concerned with the use of plastics raw materials.)

When a foreign partner is engaged in production, he normally makes his own arrangements for training workers. Since he usually supplies the know-how, he either takes some of the key workers back to his own country for training or sends his own specialists to Indonesia to provide the training.

Training in the paper industry is at present arranged by the Paper and Pulp Manufacturers Association. Theoretical training in pulp production is given at the Cellulose Research Institute, and practical training at the Padalarang paper works, under the supervision of Cellulose Research Institute staff. It has been suggested that model papermaking equipment be installed at the Research Institute so that the entire course could be carried out there, but after careful consideration it was decided that training on a scaled-down papermaking plant was not sufficiently representative and would not be worth the cost. Plans are in hand to strengthen the Cellulose Research Institute.

In cement, the position is more flexible. Workers and foremen are trained in the works; where there is foreign participation, the foreign participant often looks after the training of technicians. The Cement Research Association undertakes a certain amount of training.

VII. COUNTERPART TRAINING: SUMMARIES OF LECTURES

On Saturday mornings during the last months of his stay, the expert gave a series of lectures to members of the staff. Some of these are summarised below.

Synthetic rubbers

The difference between general purpose and speciality rubbers was explained and it was emphasized that, properly graded and compounded, there was very little advantage in replacing natural rubber (grown in Indonesia) with synthetic rubber, with the possible exception of polybutadiene for truck tires and butyl rubber for inner tubes. The production of these two types was explained, but it was made clear that for many years to come demand would not justify their production in Indonesia. Butadiene-acrylonitrile, chloroprene, ethylene-propylene, and copolymer were then described and it was explained where they fitted in to the general scheme of production for petrochemicals and what their particular advantages and disadvantages were.

SBR and isoprene rubber were dealt with at some length, their method of production outlined and the reason, largely political, which had led to their being used in such quantities in countries with no natural rubber availability. The increase in oil prices had considerably affected the prices of most synthetic rubber vis-à-vis natural rubber; it was too soon yet to see how the price differential would develop, but it would probably mean a higher price could be obtained for natural rubber.

It was recommended that no action be taken at present to instal synthetic rubber production in Indonesia.

The effect of the increase in oil prices on the demand for plastics

The posted price of crude oil in Indonesia was (per barrel) $1.67 in January 1972, $3 in October 1973 and $12.6 in July 1974. This was in keeping with world trends, but it was clear that such an unprecedented increase in the price of a raw material must have a major effect on the price of naphtha, natural gas condensate and downstream products. Some calculations showed that a 300 per cent increase in the price of crude oil brought about a 100 per cent increase in the cost of polyethylene, a 50 per cent increase in the price of

PVC and a 70 per cent increase in the cost of polypropylene. In the United Kingdom, prices for plastics and resins had increased by 50 per cent between October 1973 and July 1974 while the crude oil price increased some 300 per cent. The price index would include many expensive sophisticated resins in which the cost of crude oil played a less important part. The Japanese price increase was slightly less for the more popular plastics. Crude oil, mainly as a source of energy, is required in the production of many construction materials and the quantity required, expressed in kcal x 10^6 per tons produced, varied from 50 for aluminium to 20–30 for plastics to 10–13 for ferrous metals. On a volume basis, the quantity required for plastics was far less. The only products that might hold their own and resist any further encroachment of plastics are those from leather (shoes, artificial leather etc.) and glass (bottles). The long-term demand for plastics raw materials was then estimated macroeconomically by comparing the *per capita* growth rate in different developing countries and showing how these compared with the rate of growth in demand for cement. This led to a total of thermoplastics required for 1980 reaching 346,000 tons by 1980. (See also "Plastics" in chapter III.)

Discounted cash flow techniques

The difficulty of employing this process for individual projects under inflationary conditions was explained, but it's value in comparing variations or alternatives to the same project was stressed. A detailed example was workad out and circulated. This showed the advantages and disadvantages of building two small plants at intervals of five years compared with one large plant (twice the capacity), erection being started in the third year. Inflation was taken as 10 per cent and all figures discounted to year zero, which was taken as immediately before construction of the first small plant started. The 0.6 rule was applied to capital costs. It was assumed that the whole of the capital had been raised in the form of a loan which would have to be paid back over 10 years, with interest at 10 per cent. A five-year tax holiday was assumed. The small plants took two years from the start of construction to come on stream, and the large plant three. Development of optimum profit was slower in the case of the large plant, but at its maximum was assumed to be 33 per cent more than the combined profits of the two small plants, due to economies of scale.

During the last five years (of the 2[illegible]-year span) the profits from the first small plant were assumed to fall off as a result of an increasing need for repair and replacement. Entirely by chance, because the figures were just "educated guesses", particularly the relation between profits and investment, the two schemes each gave a discounted cash flow return of 37.5 per cent. It was emphasized that if money could be borrowed at 1[illegible] per cent, with inflation at 1[illegible] per cent, most viable processes would show a good return; but the technique was still valuable for comparison purposes.

With regard to social benefit returns, it was explained that two sites could be compared by adding to the cost of the land the cost of any crops displaced, the premium to be added to the wage costs if skilled workers had to be brought from another industry and the discount that could be made from wages paid to local, hitherto unemployed, unskilled workers. Where foreign currency saving was of vital importance, a premium could be added to all foreign payments made and possibly a discount for domestic payments, but in the case of Indonesia, which had ample foreign currency, this was rather academic.

Water and effluent treatment

Pure water was required for boilers; good-quality was required for process water and water to be recirculated; but provided it was not corrosive, low-quality water could be used for once-through cooling. Normally, filtration, usually through sand or gravel with the aid of flocculents such as aluminium sulphate, followed by softening of the water, gave the degree of purity required. For boiler water, a trace of sodium phosphate was often added to control pH and very long-chain amines added to the vapour space to prevent corrosion of the condensate surface by traces of carbon dioxide. Hydrazine (or sodium sulphite) was added to absorb the last traces of oxygen.

Where water was being recirculated, "condensate polishing" was needed to remove traces of impurities picked up; filtration plus ion exchange treatment was usually carried out.

Effluents could be discharged to rivers, the sea or into the ground, e.g. bore holes. It was considered that effluents discharged more than 2 km out to sea were harmless provided they did not contain oil, which could be removed earlier by a parallel plate intercepter. Before discharging into rivers, besides removal of oil, wastes had to be neutralized, which often resulted in the precipitation of much of the heavy metal content; this could be allowed to settle. Multi-process works often stored their effluents and blended them appropriately; much of the noxious materials were then precipitated. Activated sludge treatment, either separately or in conjunction with the local authority, was suitable for all waste containing biologically active material capable of absorbing oxygen from the water. Highly toxic effluents were often removed to the works of special operators who treated them chemically and recovered as much as possible of the useful products.

Chemicals from Indonesian minerals

Indonesia produces and exports nickel ore, bauxite, tin ore, manganese ore, copper ore and iron sands. Dolomite and molybdenum ore are available but not worked. Small quantities of silver and gold and iodine are produced. Some iron is processed locally and plans are in hand to process copper using the sulphur dioxide produced to make sulphuric acid for fertilizers. Only relatively small proportions, of the order of 5 per cent on a world basis, are used for making chemicals; the remainder of the ores are worked up for the metals or alloys.

The most useful outlets for minerals in the chemical field are in the production of catalysts and the manufacture of plastic additives. Manganese, iron, nickel, molybdenum and aluminium are all used in catalyst form in petroleum refining, the production of petrochemicals and the polymerisation of plastic monomers. Many of the catalysts have to be prepared to a high degree of purity and in a special physical form and have a high value with regard to the quantity of material in them. Their production and testing are, for the chemical industry, relatively labour-intensive while their weight/value relationship makes it relatively cheap to send them long distances by air. This is, therefore, a field that should be investigated in some depth. Contact would need to be made with a foreign catalyst manufacturer who would supply the know-how and possibly become an investor.

The main plastic additives are organic compounds of nickel, which act as UV absorbers when added to polypropylene and other polyolefins, and organo and tin compounds as heat stabilisers, particularly for PVC. When it is realised that 0.5-1.0 may have to be added to the plastic raw materials and that Indonesia is contemplating the production of perhaps 40,000 t/a of polypropylene (20,000 already in production) and 100,000 t/a of PVC it will be seen th t the tonnage of additive needed will be quite appreciable. Here again, a study in depth is justified as, quite apart from export to neighbouring countries, where as yet there is no production, there would be sufficient demand locally to justify the plant.

Other chemical applications are nickel hydroxide for alkaline storage batteries and manganese dioxide for dry batteries. Manganese salts of organic acids (naphthenic acid from petroleum) are used as accelerators for drying oils in paints; similar copper salts are used as fungicides and wood preservatives. Molybdenum disulphide is a valuable constituent of lubricating oils while copper and aluminium and some tin compounds are used as mordants in dyeing. Nickel sulphate is used in nickel plating. Sodium (or potassium) permanganate is a powerful oxidizing agent and disinfectant. Iodine compounds are widely used in human and animal medicines.

While many of these may prove useful outlets, it is suggested that a start be made with two mentioned above; catalysts and plastics additives.

VIII. RECOMMENDATIONS

The principal recommendations are that:

1. In-depth technical studies be carried out on chlorine; dyestuffs and organic pigments; nitric acid; methanol; carboxylic acid; UV absorbers for plastics; catalysts for petrochemicals and plastics; sodium tripolyphosphate (a comprehensive proposal for Perum Petrokimia); DDT; phenoxyacetic acids; and organic phosphorus insecticides, particularly malathion and diazinon;

2. A body be set up to provide a two-way flow of information between producers and users of chemicals;

3. The Government should introduce a patent law to safeguard the interests of companies bringing novel techniques into Indonesia;

4. Pertamina should be advised to expand the cyclohexane plant and to leave sufficient flexibility in the process to isolate toluene if required;

5. The caprolactam plant should be sited near the East Kalimantan ammonia plant and not at Gresik, in order to leave the Gresik plant for inorganic production and to save transport costs;

6. The collection of input and output statistics should be continued, but with much more detailed classification, and guarantees of confidentiality. Production of chemicals and plastics by Pertamina should be included;

7. The Central Bureau of Statistics be encouraged to carry out an industry survey, as was done in 1971, but all users of chemicals should be included, the oil industry in particular;

8. Studies on specific products for which outside investment is required should be circulated to all companies which produce the product and which might be induced to invest in Indonesia.

Annex I

SECOND NATIONAL FIVE-YEAR PLAN: THE CHEMICAL INDUSTRY a/

Paper

Before Plan I, most paper production in Indonesia was based on the use of rice straw pulp. Production capacity was small and equipment was old and of very low efficiency. In order to meet the increasing demand for paper, both in quantity and in quality, it was decided to change to better raw materials, for example to bamboo and other woods. But for this purpose large production units are required. Projects are currently being carried out in Gowa, South Sulawesi. Banyuwangi, East Java, will be further developed and, when completed, will produce at the design capacity of 30 tons per day. In order to increase the efficiency of the other existing mills, rehabilitation work will be carried out. At the same time, the paper mill at Padalarang and the one at Leces will be expanded. The growth of paper production during Plan I was:

	Tons
1969/70	17,000
1970/71	22,000
1971/72	30,000
1972/73	39,000
1973/74	40,000

The paper industry in Indonesia is still at a low efficiency level. This is mainly the result of the low capacity of the various plants, a capacity which is far below that needed for proper efficiency. The capacity of the average paper mill at present is about 50 tons per day while the capacity required to achieve a proper degree of efficiency is estimated at ten times that amount.

Existing mills can meet competition only with the aid of protective duties, which for some kinds of paper would have to be very high. Efforts to transfer the development of new paper industries to the private sector, such as the proposed paper mills using pinus wood as raw material in Notog, Central Java, and in Takengon, Aceh, have not proved successful. These were planned for Plan I, with private capital investment, but, owing to shortage of both raw material and capital, as well as to other difficulties, they were never erected.

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a/ A free translation of the original text.

The pulp and paper industry should utilize the natural resources of the forests of Indonesia, which are available in considerable quantity. This industry is a fundamental one and is needed to accelerate the over-all development of the industrial sector. Therefore, during Plan I a survey was carried out in order to study the best sources of raw materials, the marketing possibilities for the various kinds of paper and paper goods, the most suitable locations for mills, and the minimum viable capacity. Based on this survey, a master plan for the development of the pulp and paper industry can be drawn up and two potential forest areas for long-fibre wood can be identified: the pinus wood in Aceh and the agathis in Central Java, both of which can be used for pulp for several different kinds of paper. On the other hand, the short-fibre tropical wood in East Kalimantan, East Sumatra, Riau and West Irian will be devoted to the use of those wood industries that need short fibre such as sawn timber, veneers and plywood.

In order to determine the supply of raw material in Aceh and Central Java it is necessary to carry out a still more detailed forest inventory. Besides that, it will be necessary to investigate the scope for expansion, particularly in the neighbourhood of the proposed plant site. The possibility of using the short-fibre wood from East Kalimantan for newsprint also needs study.

In view of the great demand for paper, the natural resources have to be properly utilized by producing paper in large units. In this way manufacturing units can be run at a profit and compete in the international market.

The policy with regard to the development of the pulp and paper industry initiated during Plan I will be continued in Plan II. In addition, opportunities will be given for investment in paper mills that are making use of imported pulp and domestic waste paper. Products that could be produced include writing paper, packaging paper, toilet paper and cardboard. Other raw materials, such as bagasse from sugar mills, will also be tried for the production of paper. If the efforts to use bagasse are successful and the major plant in Central Java can be put on stream in Plan II the estimated annual increase in the production of and demand for paper will be as follows:

	Production (tons)	Demand (tons)
1974/75	47,300	265,000
1975/76	51,400	300,000

1976/77	[illegible]	344,2
1977/78	117,2	[illegible]
1978/79	[illegible]	465,1

As can be seen from the above estimates, the demand projection is still greater than the production estimates for years to come, therefore, a substantial part of the demand for paper will have to be satisfied from imports. Should, within the next few years, the opportunity be offered for further new production units, these will most certainly be investigated.

Chemicals and tires

This main group covers the broad field of chemicals, such as the production of gases, acids and chemical salts, the production of fertilizers, such as urea and phosphates and pesticides, plastic materials and synthetic fibres, together with the tire industry.

The development of capital-intensive, basic chemical industries has not proceeded very far. The activities in the field of basic chemicals and fertilizers are generally the result of the rehabilitation and expansion of government enterprises, such as the caustic soda-chlorine works of P. N. Soda Waru, fertiliser factories, e.g. P. T. Pubuk Sriwijaya and Perum Petrokimia in Gresik and P. N. Garam in Madura, and the acid factory of P. T. Aneka Gas Industri. This is mainly because large units are required for the production of base chemicals to be viable. Moreover, the demand for the products from such units was not sufficiently developed in the early years of Plan I to support these activities. During that time, the chemical-using industries were mainly light industries producing consumer goods that had been previously imported. These industries generally processed imported basic materials to finished goods through simple processing steps which did not call for large capital investment. As a result however of the development of investment, production has shifted in recent years from light industry processing of imports into goods for consumption towards raw materials processing.

This development will be taken a stage further if the import of the raw materials can be replaced by domestic production. Raw material or base chemical-producing industries will constitute a core around which developments in various sectors of industry as well as other economic activities will be strongly encouraged. Efforts to develop such a core will be carried out gradually and systematically, with special reference to the planning of productive units that will be able to process raw materials as efficiently as possible and to produce basic materials to replace imports both in quality and price. In order to make this possible, national surveys were carried out during Plan I to obtain an estimate of the growth of demand in Indonesia and in other countries and on the availability of the resources from which the base chemicals, i.e. the raw materials of the consuming industries, could be produced. Among the industries surveyed are: fertilisers; petrochemicals; acids; base chemicals derived from acids; synthetic fibres; and pesticides.

A Commission on National Fertiliser Affairs was established to follow up the recommendations of the National Fertiliser Survey and to sponsor a survey on the fertilizer project in West Java that will utilise the natural gas available in that area.

The construction of new fertiliser factories is expected to take place during Plan II, namely the fertiliser factories in West Java and East Kalimantan with capacities of 1,000 tons and 1,500 tons of ammonia per day respectively. The fertiliser factory in East Kalimantan will use 1,000 tons of ammonia a day for the production of urea and another 500 tons for other purposes. When compared with the expansion of the Pusri factory, amounting to 660 tons of ammonia per day, the new factories will show an advance in the application of modern technology. In the meantime, it is planned to produce TSP in the petrochemical factory at Gresik. Should these efforts be realised, then with the expansion of Pusri, which will be completed at the beginning of Plan II, together with the petrochemical factory in Gresik, the estimated annual production of domestic fertilisers will be:

	N (tons)	P_2O_5 (tons)
1974/75	110,000	-
1975/76	215,000	-
1976/77	426,000	20,000
1977/78	470,000	77,000
1978/79	657,000	177,000

The petrochemical industry was started by the construction at Plaju of a polypropylene plant with a capacity of 20,000 tons per year, which started to produce in 1973. This factory has no connection with other petrochemical products because it is using the propylene from the waste gases from the oil refinery. The construction of plants for the production of other polymers, such as [illegible], is also in progress.

The plastic goods from the petrochemical industry at present consist principally of plastic sheets ([illegible] per cent), household goods such as bottles and buckets (2[illegible] per cent) and foot-wear such as sandals and shoes ([illegible] per cent). Other uses are in building and construction, e.g. pipes and plastic sheets, and for industrial needs, e.g. electrical insulation and photographic products.

The nationa[illegible] carried [illegible] Plan [illegible] was geared towards the [illegible] of a petrochemical complex that would produce at least ten different kinds of products: low-density and high-density polyethylene (LDPE and HDPE) for the production of plastic goods; vinyl chloride monomer (VCM) for the production of [illegible], polystyrene ([illegible]) and polypropylene (PP) for the production of plastic goods; [illegible] phthalate ([illegible]) for use as a plasticizer in the production of plastic goods; terephthalic acid ([illegible]) and ethylene glycol (EG) as materials for the production of polyester synthetic fibres; and caprolactam as the base material for the production of nylon.

The petrochemical industry will be based on naphtha (a product of the oil refinery) or natural gas, which will be processed into ethylene and propylene, the building blocks from which the petrochemical products mentioned above are made.

Further investigation will be made into the best site, bearing in mind the availability of raw material, and the location will be determined at the beginning of Plan [illegible] so that construction can be in progress by the end of that Plan or the beginning of Plan [illegible]. This work is expected to be carried out with the assistance of the private sector. Meanwhile, the construction of a synthetic fibre industry, based on polyesters, will get underway with the aid of foreign capital investment, the base materials being imported in the early stages.

The national survey of the basic chemical industry, which has now been carried out, has also been directed to the production of chemicals, but from salt, such as caustic soda, soda ash, chlorine and hydrochloric acid. In the case of salt, efforts will be made during Plan [illegible] to continue to improve the quality of the product, both for industry and for consumption. The demand for caustic soda is already substantial, but domestic production is only on a modest scale. With the possibility of an aluminium project in Asahan, the potential demand [illegible] increase. However, the caustic soda industry cannot be developed yet, because the demand for chlorine, which constitutes a complementary product, is expected during Plan II by the petrochemical industry. The development of the caustic soda industry will be adjusted to meet the requirements of the petrochemical industry and the aluminium industry in Asahan.

[illegible] rubber, it is obvious that Indonesia should [illegible] industry. [illegible], because the greater part of the compounding materials [illegible] imported, this industry has not been expanded [illegible] means that production costs are not [illegible]

[illegible] the production of motorcycle tires in the country can meet the greater part of the national needs. To make sure the industry [illegible] manner, however, protection will be gradually reduced so that the [illegible] will be able to direct its output for export.

[illegible] increasing demand for tires for motor vehicles will be met by the expansion of existing plants through new capital investments. [illegible] an estimate of the annual production of and demand for motor [illegible]

	Production (million tires)	Demand (million tires)
[illegible]	1.55	1.92
[illegible]	[illegible]	[illegible]
[illegible]	2.47	2.30
[illegible]	[illegible]	2.57
[illegible]	[illegible]	2.8

[illegible] stimulate the export of other rubber goods that require [illegible] imported compounding material and other ancillary materials, [illegible] necessary to exempt these materials from import duty.

[illegible] bicycle tires, which was started in Plan I, will [illegible] increased. The rubber and rubber goods industry is estimated [illegible] at an average growth of 8.1 per cent per year.

Cement and glass

Cement

The use of cement in Indonesia increased very rapidly during Plan I. Apparently, the increase was in line with the increase in general construction. Table [illegible], showing the production and import of cement during the past five years, reveals an increasing use of cement. The production figures for [illegible]73 were: Gresik 4[illegible], [illegible] tons; Padang 22[illegible], [illegible] tons; and Tonassa 11[illegible], [illegible] tons.

Table [illegible]. Cement production and import, 19[illegible] - 1973/74
(Thousands of tons)

	Production	Import	Total
19[illegible]	[illegible]41	[illegible]13	1,[illegible]4
197[illegible]71	5[illegible]	[illegible]	1,[illegible]
1971/72	[illegible]3	[illegible]	1,44[illegible]
1972/[illegible]	[illegible]22	1,[illegible]	1,[illegible]
[illegible]74	[illegible]	[illegible]	1,95

Table [illegible] reveals that demand increased far more rapidly than production and that there was an increase in imports during the period. This growth consumed a lot of foreign currency. [illegible] the countries that had normally been exporting cement began [illegible] their [illegible] to meet their own domestic demand. In order to increase cement production, [illegible] cement plants are at present under construction at [illegible]. One of the plants was scheduled for completion in [illegible]4 with a production rate of [illegible] t/a. This will be followed by an extension with a capacity of [illegible] t/a. Another plant, with a capacity of 5[illegible] t/a, is under construction and will come on stream in 1975.

At present, the Padang cement plant is planning to optimise the existing unit and hopes that the work will be completed by the end of 1975; its production will then increase by 11[illegible] t/a. In the neighbourhood of this factory, another cement plant, with a capacity of 5[illegible] t/a, is under construction. This plant will not only help to meet the domestic demand for cement, it is also expected to extend the life of the Ombilin coal mine and the railway service of West Sumatra and it will also help to develop the port of Teluk Bayur, thereby substantially supporting the development of the region. Further, it is planned

(a) to expand the Cibinong cement plant in order to attain a rate of production of 1 million t/a; (b) to expand the Tonasa cement plant to an increase in production from 12[illegible] t/a to 620,000 t/a; and (c) to construct other cement plants in West Java, Central Java, South Sumatra, North Sumatra and Aceh. These plans were initiated during Plan I but the results will not be fully seen until the beginning of Plan III. If part of the projects are completed within the Second Plan period, the demand for cement may be met. However since the projects will be completed only after 1975, cement imports will still be necessary in 1974 and 1975.

Table 31 shows the planned growth in the production of and demand for cement. From this it appears that there will be a fourfold increase in production while the demand will almost double. If the demand for cement is correctly forecast, then by the last year of Plan II, there will be a surplus, which may be exported. Therefore, investment in the above cement plants need to take export possibilities into account by assessing the international cement market situation.

Table 31. Estimated production of and demand for cement, 1974/75–1978/79
(Thousands of tons)

	Production	Demand	Imports
[illegible]	[illegible]	2,2[illegible]	1,31[illegible]
[illegible]	[illegible]	2,66[illegible]	1,[illegible]
[illegible]	3,125	3,135	1[illegible]
[illegible]	4,363	3,71[illegible]	-
[illegible]	5,135	4,395	-

Glass

During Plan I, construction of a large glass bottle factory was completed. The demand for plate glass and bottles is estimated to increase during Plan II so that increasing facilities for production are expected (see table 32).

Table 32. Estimated production of and demand for glass plate and bottles
(Thousands of tons)

	Glass plate		Glass bottles	
	Production	Demand	Production	Demand
1974/75	27.0	38.1	61	60.9
1975/76	32.8	41.9	63	67.0
1976/77	44.6	46.1	71	73.6
1977/78[a]	46.3	50.7	85	89.1
1978/79	46.3	55.8	85	89.1

a/ The figures for 1977/78 have been copied from the document provided, but it is suggested that there are typographical errors.

Annex II

THE PLASTICS CENTRE

Considerable enthusiasm has been expressed in some quarters for the establishment of a Plastics Centre along the lines suggested by UNIDO, incorporating information, testing and training services, and providing specifications and various kinds of assistance to processors. Companies currently processing plastics seemed reasonably interested, but would want to see what the Centre could do before committing any finance.

There is little possibility of a completely independent organization being set up. If anything there are too many institutes and research centres now, mostly with insufficient funds to carry on a proper job.

Two organizations, however, are keen to have a Plastics Centre as part of their activities:

(a) The Director of Research and Training, responsible to the Secretary General of the Ministry of Industry, has planned to establish a Plastics Centre, partly at the Materials Testing Centre at Bandung and partly, with the aid of the United Kingdom Government, at the Leather Research Institute at Yogyakarta;

(b) Lemigas (the Institute of Petroleum) which is responsible to the Ministry of Mines (not to the Ministry of Industry), has decided to establish a Plastics Centre at its laboratories at Cipulir on the outskirts of Jakarta and has the support of the Director-General of the Chemical Industries. Lemigas is in no way controlled by Pertamina (the state oil organization), but carries out a lot of training and testing for this institute and much of its finance results from this.

The (b) plan may proceed, possibly handling petrochemicals in a wider sense, whether or not UNIDO support is given. Scheme (a) will need the support of an outside party such as UNIDO. (Negotiations with the United Kingdom Government appear to be, at least temporarily, at a standstill.)

While the Director-General of Light Industries has not expressed a personal opinion to the expert, the Director of Development definitely prefers scheme (a) or some similar plan that would keep the Plastics Centre under the control of the Ministry of Industry. (The 45 or so companies in the plastics processing field are considered part of Light Industries.)

Both parties tried to get their representatives on to the Plastics Training Course at Vienna. The Director of the Leather Research Institute was nominated, without the knowledge of the expert, but was turned down due to lack of experience in the plastics technology. He was, however, given a fellowship to study research institutes in general.

The expert paid a visit to the Leather Research Institute and decided that UNIDO funds could be used to better advantage in strengthening its activities as a Leather Institute rather than expanding it to cover plastics. Among other reasons, there was not enough accommodation and space for new building was very restricted.

At the suggestion of the Director of Research and Training, the expert visited a new block of laboratories at Surabaya, part of which could be made available as a Plastics Centre. Again, these were not large enough to take the heavy equipment needed and while there was just space for a further building, the other purposes for which the laboratory was to be devoted (the testing of metals, essential oil and foodstuffs) were not ideal companions for a Plastics Centre.

In the opinion of the expert, if UNIDO feels its mission is to strengthen existing institutes, then the Directorate of Research and Training should be given support. On the other hand if the welfare of the existing plastics industry is the first consideration, then Lemigas is the right choice.

After discussion with the Director of Lemigas and others, the suggestions of the expert are that if it is decided to have the Plastics Centre at Lemigas, then UNIDO could assist by:

(a) Supplying a plastics processing equipment specialist (preferably not from one of the major industrial countries) to advise on the equipment necessary;

(b) Supplying a lecturer in basic plastics technology (materials and testing) for 3 months (December 1975 - February 1976);

(c) Supplying a lecturer on the processing of plastics (for 3 months, December 1975 - February 1976);

(d) Supplying a specialist in the analysis of plastics to work alongside a counterpart (early 1976);

(e) Supplying a specialist in the operation of plastics processing equipment to train instructors in the use of the equipment installed. The time should be as soon as possible after the installation of the equipment.

Annex III

PRINCIPAL CONTACTS IN INDONESIA

VICE PRESIDENT'S OFFICE

Surjo Sediono, Assistant to the Vice President

MINISTRY OF INDUSTRY

Achmad Slamet, Secretary General

DIRECTORATE GENERAL OF THE CHEMICAL INDUSTRY

Agus Sujono, Director General

Moh. Samadi, Director, Development

Salmon Mustafa, Director, Implementation

Hartarto, Director, Existing Production

Alchaidi Elias, Director, Administration

TEXTILE RESEARCH INSTITUTE

Hardjito Tringgo Sudirdjo, Director

DIRECTORATE GENERAL OF LIGHT INDUSTRIES

Soegiri Soemodarsono, Director General

DIRECTORATE GENERAL OF TEXTILE INDUSTRIES

Iman Sujipto, Director General

DIRECTORATE GENERAL OF BASIC INDUSTRIES

Sulaiman Said, Director General

DIRECTORATE GENERAL OF OIL AND GAS

M. Pandjaitan, Director General

LEMIGAS, [illegible]

Sjarif A. Loebis, Director

LEMIGAS TRAINING CENTRE, CEPU

A. Mamesah, Deputy Director and in charge of Training Centre

MINISTRY OF AGRICULTURE

A. Sahulata, Secretary to the Fertiliser Board

Muljani, Secretary to the Pesticide Committee

CENTRAL BUREAU OF STATISTICS

Suwandi, Import and Export Statistics

Marlan Hendro, Production Statistics

LEATHER RESEARCH INSTITUTE YOGYAKARTA

R. Sunyoto, Industrial Development and Economics

Protomuljono, Scientific Information and Training

Sudarjo, Lecturer in Leather Technology

MATERIALS TESTING LABORATORY, BANDUNG

M. Mustarid, Chemical Analysis

U. Rustandi, Fuel and Lubricants

T. Suhana, Paints, Plastics and Organic Products

P. Husan, Building Materials

CHEMICAL RESEARCH INSTITUTE, BOGOR

Dardjo Somaatmadja, Director

TEXTILE TECHNOLOGY INSTITUTE, BANDUNG

Wibowo Moerdoko

CHEMICAL RESEARCH LABORATORY, SURABAYA

M. Satari, Manager

PERTAMINA, HEAD OFFICE

Pudjadi Sukarno, Project Manager, Aromatics

PERTAMINA, UNIT 2 PLAJU

G. J. Atihuta, Technological Superintendent

PERTAMINA, PLASTICS SALES SERVICE LABORATORY

Ny. E. A. Matulanda Sugandi, Deputy Director

PERUM PETROKIMIA, GRESIK

James Simandjuntak, Managing Director

P. T. SEMEN GRESIK

Mono Lekatompessy, Research Manager

P. T. BAYER AGROCHEMICALS

Gerd Walbrecht, Managing Director

P. T. FARMA INDONESIA

R. Below, Production Director

BERLINA P. T.

S. Santo, Marketing Manager

P. T. DUA MUTIARA CHEMICAL CO. (DUMACO)

K. Ohguro, Manager

Kasdi, Accountant

P. T. EASTERN POLYMERS

S. S. Sugito, Assistant General Manager Finance

Su Chung Cheng, Plant Manager

Soengkowo Soengkoeng, Technical Superintendent

P. T. GOLLIN INDONESIAN DEVELOPMENT CO.

L. M. Levinson, Overseas Division

HOECHTS INDONESIA P. T.

W. Volkamer, Assistant Manager, Industrial Div.

UNIE VAN KUNSTMEST FABRIEKEN B. V.

T. Tuinstra, Agronomist

P. T. INTIRUB, JAKARTA

J. T. Frederick, Vice President, Production

Philip Colclough, Chemist

P. T. KARPLINDO ABADI

A. Nasution, Managing Director

P. T. KARUNA

Achmad Soemarsono, Managing Director (Commercial)

R. Tjipto, Managing Director (Manufacturing)

P. T. MOBIL INDONESIA

W. Rama

P. T. PIONEER PLASTICS

Pandji Wisaksono, President Director

P. T. POWER CABLES

K. S. Parameswaran, Project Manager

P. T. RHODIA INDONESIA

Thierry Poulenc, General Manager

P. T. WAVIN DUTA JAVA

A. Van de Belt, Managing Director

A.K.Z.O. ZOUT CHEMIE

G. A. Van Driem, Business Development

A. N. Heijstek, Market Research Manager

S and W BERESFORD LTD

H. P. Scholte, Representative for Indonesia

J. M. Patterson, Technical Manager (British Pepper and Spice Ltd)

BROKEN HILL SOUTH LTD

Richard M. Morgan

CAPITAL PLANT INTERNATIONAL LTD

D. Lennan, Managing Director

CIBA-GEIGY

R. Widmer, General Manager

GOODYEAR TIRE AND RUBBER CO.

G. Nelson Chambers, President

I.C.I. GROUP

W. Dunlop, Chief Executive

SHELL INTERNATIONAL CHEMICAL CO., REPRESENTATION INDONESIA

E. Mesritz, General Manager

UNICO

S. Maeno, Resident Representative

UNILEVER INDONESIA

R. H. Hadjiwibowo, Director

D. G. Bullock, Marketing Manager

UNION CARBIDE ASIA LTD

W. D. Batjer, Manager

BRITISH EMBASSY

Willis Combs, Ambassador

FRENCH EMBASSY

J. F. Moreau, Commercial Attaché

WEST GERMAN EMBASSY

I. Saunweber, Commercial Attaché

UNITED STATES EMBASSY

Thipto Minoto, Commercial Assistant

AGENCY FOR INTERNATIONAL DEVELOPMENT AND TENNESSEE VALLEY AUTHORITY

aul Stangel

BAPPENAS

Sugene Sundjaswadi

UNITED NATIONS

A. . Garcia, Resident Representative

. Wastengren, Senior Industrial Development Field Adviser

R. S. Sharma, UNIDO Policy Adviser to the Ministry of Industry

FAO

. D. Swyer, Agricultural Planning

. . Haney, Fertiliser Marketing and Credit

WHO

. Verdrager, Senior Malariologist

INTERNATIONAL BANK FOR RECONSTRUCTION AND DEVELOPMENT

. . Grossman

A. Storrar, Senior Agricultural Adivser

R. . Jones, International Finance Corporation

B. Gura, Office of Technical Co-operation, Statistics

I. Weiss

K. . . Nair

S. N. Dar

A. Menhinick

Annex IV

[illegible] AND [illegible] RAW MA[illegible]
[illegible], 1973

All figures are in tons net, an approximate allowance having been made for packages. As these figures were obtained at the end of the expert's stay, they may differ slightly from figures given in the text, which were, in many cases, based on preliminary calculations.

	Tons
Sulphur	11,2[illegible]
Carbon black	7,500
Oxygen	[illegible],1[illegible]
Hydrogen chloride	2,[illegible]
Caustic soda	45,000
Caustic potash and other alkalis	7,[illegible]
Zinc oxide, including peroxide	2,[illegible]
Manganese dioxide	3,6[illegible]
Aluminium oxide	[illegible]
Titanium dioxide	4,[illegible]
Ammonium chloride	5,2[illegible]
Miscellaneous chlorides	2,8[illegible]
Chlorites	2,7[illegible]
Chlorates and perchlorates	1,9[illegible]
Sodium sulphite	2,25[illegible]
Aluminium sulphate	3,5[illegible]
Alums	3,8[illegible]
Other sulphates	5,1[illegible]
Phosphates and phosphites	[illegible],5[illegible]
Soda ash	25,[illegible]
Other carbonates	25,[illegible]
Sodium silicate	8,[illegible]
Borates	1,700
Hydrogen peroxide	1,200
Calcium carbide	10,180

	Tons
Halogen derivatives of hydrocarbons	7[illegible],8[illegible]
Sulphonated derivatives of hydrocarbons	7,3[illegible]
Methyl alcohol	2,82[illegible]
Other alcohols	1,2[illegible]
Formaldehyde	56[illegible]
Other aldehydes	46[illegible]
Formic acid	4,5[illegible]
Acetic acid	1,36[illegible]
Other carboxylic acids	8,8[illegible]
Ammonium sulphate	52,500
Urea	140,000
Ammonium nitrate	1,300
Other N fertilizers	118,000
P_2O_5 fertilizers	215,000
K_2O fertilizers	70,800
Other fertilizers	6,600
Organic dyestuffs	7,800
Disinfectants	9,320
Miscellaneous chemical products a/	49,400

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a/ These are mostly mixtures prepared in this form as a result of chemical processes. Mixtures obtained by deliberately mixing two products are excluded.

The following calculations of imports of plastics raw materials and finished products are based on 1973 import statistics.

	Tons
Raw materials	
Condensation products	2,300
Polymerization products	93,800
Cellulose derivatives	11,300
Natural polymers	8,[illegible]
Other polymers b/	11,[illegible]
Total	127,900
Semi-finished products (sheets, blocks, tubes, foams etc.)	
Condensation products	[illegible]
Polymerization products	5,100
Cellulose derivatives	1,920
Other polymers b/	[illegible]
Total	7,090
Scrap	[illegible]
Finished products (plastic content estimated where necessary)	
Bags	1,180
Tools	[illegible]
Roofs	[illegible]
Domestic articles	[illegible]
Supported sheet (leather cloth)	3,900
Shoes and sandals	190
Furniture	60
Tooth-brushes	[illegible]
Toys	890
Buttons	160
Ball-point pens	[illegible]
Combs	95
Hair slides	55
Electric fittings	[illegible]
Plastic insulated cables	[illegible]
Other articles	[illegible]
Total	13,690
Grand total	140,[illegible]

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b/ Probably incorrectly classified and are mostly polymerization products or condensation products under various trade names. An attempt is being made by the statistical office to break polymerization and cellulose raw materials into a greater number of subdivisions. Results so far obtained are: polyethylenes, 42,980; polystyrene, 2,796; polypropylene, 8,090; and cellulose plastics, 15,606.

Annex V

A[illegible] ON CHEMICALS AND [illegible] MA[illegible] [illegible]

The tariff on inorganic chemicals is 15 per cent, with the following exceptions:

	Per cent		Per cent
Chlorine	2	Hydrochloric acid	4
Other halogens	[illegible]	Sulphuric acid	[illegible]
Carbon	1	Mercury	[illegible]
Oxygen	4	Alkali and alkaline earth metals, rare earth metals and their alloys	[illegible]
Sulphur	1		

The tariff on organic chemicals is 1[illegible] per cent, with the following exceptions:

	Per cent
Methyl alcohol	2
Other alcohols, including their chlorinated or sulphonated derivatives	2
Diethyl ether	2
Complex ethers, ether alcohols and phenol ethers	2
Vanillin, heliotropin	2
Camphor	[illegible]
Ionone	4
Ketones generally, ketone alchols, keto-phenols, quinones, keto- and quinone-aldehydes	4
Carboxylic acids	1
Nitrogen derivatives generally	2[illegible]
except nitrile compounds	4[illegible]
sodium cyclamate	4[illegible]
Organometallic and organo-inorganic compounds	2[illegible]
Vitamins	1[illegible]
Hormones	5
Enzymes	5
Alkaloids	5
Antibiotics	5

	per cent
[illegible]	5
[illegible] of chemical compounds which are [illegible] mixtures	2
[illegible] raw materials [illegible] liquids, granules etc.	1
[illegible] raw materials [illegible] as emulsions	10
[illegible] sheets [illegible] and semi-finished [illegible]	6
[illegible] made from plastics	6
[illegible]	2[illegible]
[illegible]	3
[illegible]	1
[illegible] synthetic rubber	2
	Rp per kilo
[illegible]	1 -1,1[illegible]
[illegible]ener	3,[illegible]

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1 [illegible] availability from Indonesian production. Import of some [illegible] required.

Annex VI

POLYOLEFINS: LATE FIGURES

Table 33 shows prices of polyolefins, duty paid and delivered, that were received too late to be taken into account in the calculations submitted in this report. It is perhaps surprising that they do not show more clearly the effect of the increase in oil prices, but like the Japanese prices (a high proportion of the materials come from Japan) they seem to reach a maximum and then fall as though actual shortage rather than the higher crude prices, is the determining factor. In any case, as they are about twice the Japanese prices, shipment costs and other factors, such as sale in relatively small quantities, may again partly nullify the effect of the raw materials costs.

Table 33. Polyolefins, duty paid and delivered
(Rp per kg)

	LDPE	HDPE	PP
November 1973	380–400	375–390	490–500
December 1973	400–420	435–450	550
January 1974	550–575	500	600–700
February 1974	550–600	500	700–750
March 1974	475	550–600	700
April 1974	450	n.a.	n.a.
June 1974	400–425	n.a.	650–675
July 1974	375–400	n.a.	n.a.
October 1974	375–400	430	475

[redacted]

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