6 Summary of Research and Technical Guidance Organizations related to Ceramics Industry

6.1 Institute for Research and Development of Ceramic Industry (IRDCRI)

(Balai Besar Penelitian dan Pengembangan Industri Keramik: BBK)

6.1.1 General

BBK was established in Bandung in 1922, as Ceramic Research Laboratory under assistance of the Dutch government. In 1950, it was reorganized to Ceramic Research Institute with expanded R&D functions. In 1980, it was reorganized as an organization under Research and Development Agency of the Ministry of Industry, renamed to the present name.

As shown in Figure 6-1, BBK consists of Administration Division, Heavy Ceramic Research Division, Fine Ceramic Research Division, Heavy Ceramic Development Division, and Fine Ceramic Development Division, as well as laboratories and workshops.

BBK has 203 employees in total (Table 6-1), which are divided into 71 in Administrative Division and 132 in R&D divisions. Heavy Ceramic Research Division is staffed by 21 persons, Heavy Ceramic Development Division 37, Fine Ceramic Research Division 25, and Fine Ceramic Development Division 36. As for educational background, 43 employees are university graduates, 15 academy (three-year college) graduates, and 145 have high school or lower levels of education. By field of interest, there is one Ph.D. holder and two master's degree holders in ceramic engineering, two masters of chemistry, 13 bachelor's degree holders and 9 academy graduates in technical science, 13 bachelor's degree holders and 2 academic graduates in social science, 8 bachelor's degree holders and 2 academy graduates in chemistry, and 4 bachelors of arts.

6.1.2 Activity description

6.1.2.1 R&D activities

- Refining and processing of ceramic raw materials

To perform general evaluation of raw materials ceramic and glass industries by means of geological survey and evaluation; to study and evaluate technological resources applicable to commercial production; and to perform verification tests in laboratory or at pilot plant to examine suitability of raw materials and resources for ceramics production.

- Production technology

Research and development on industrialization of ceramic products, including structural clay, stone ware, and refractory

6.1.2.2 Industrial process design and engineering activities

- Furnace and kiln related activities

Furnace design and construction; setting and optimization of furnaces and kilns; application of refractories and heat insulation materials; and design and engineering of temperature control and heat recovery systems

- Technical assistance related activities

Support for technological and economic research activities for capital investment projects, including modernization of old ceramic plants; evaluation of ceramic plant construction plans; and various technical assistance and consultation activities in the field of ceramics

6.1.2.3 Testing, standardization and certification activities

Testing of ceramic materials and products in relation to quality control systems; standardization of equipment and machinery, testing methods, products, and raw materials; certification tests on quality systems for ceramic, glass, and enamel factories; ISO 9000 based quality assurance under BBK Quality Assurance Certification Scheme (BBK-QACS). BBK is required under No.13/BPPI/IX/1994 of Industrial Research and Development Agency of the Ministry of Industry to perform, and perform verification tests on Module 1 management systems for the following products and quality tests on sample products.

Ceramic Building Material: especially Tiles, Brick, Roofing-Tiles, Cement, Lime etc.

Sanitary Ware:	especially Bathtubs, Closets, Urinals, Lavatories
Technical Ware:	especially Insulators, Textile Machinery Spare Parts, Refractories Resistors, Abrasive etc.
Items made of Glass:	especially Ampoules/Vials, Bottles, Drinking Glass, Optical Glass, Safety Glass, Reflective Glass
Enamel Ware:	especially Bathtub, Cooking Ware, Technical Ware etc.
Facilities and Machineries in Ceramic Manufacturing Factories:	for instance Brick Pressing Machine, Tile Pressing Machine, Extruder etc.

BBK has a testing laboratory for ceramic raw materials, such as Clay, Feldspar, Quartz Sand, Kaolin, Dolomite, Oxides.

At present 4 testing laboratories in BBK, (1) Ceramic Tile Laboratory (2) Table Ware Laboratory (3) Glass Laboratory (4) Glazed Roofing Laboratory are accredited as ISO 25 laboratory by National Accreditation Committee. Detailed testing items in each laboratory are as follows.

(1) Ceramic Tile Laboratory

Ceramic Tile Products, Wall, Floor, Granite and Split Tiles are examined here. Examination items are

Dimension:	Size, Rectangularity, Surface Flatness, Side Straightness, Edge Straightness
Mechanical Properties:	Abrasion Resistance, Bending Strength, Hardness
Physical Properties:	Water Absorption, Glaze Resistance to Crazing, Resistance of Thermal Shock
Chemical Properties:	Resistance to Chemicals

(2) Table Ware Laboratory

Table Ware Products such as Dishes, Bowl, Cup are examined here. Examination items are

Mechanical Properties:	Impact Strength, Hardness
Physical Properties:	Glaze Resistance Against Crazing, Resistance of Thermal Shock
Chemical Properties:	Solubility of Lead and Cadmium

(3) Glass Laboratory

Glass Products are examined here. Examination items are

Dimension:	Size, Rectangularity, Flatness
Physical Properties:	Resistance to UV, Resistance to Thermal, Resistance to Humidity
Mechanical Properties:	Impact Strength using Impact Pocket, Steel Ball or Mannequin (Head of Testing Toy), Abrasion Resistance Fragmentation

(4) Glazed Roofing Laboratory

Glazed Roofing Tile Products are examined here. Examination items are

Dimension	
Mechanical Properties:	Resistance to Bending Load
Physical Properties:	Water Absorption, Glaze Resistance to Thermal Shock

6.1.2.4 Training activities

BBK provides a wide range of service, including technical training for operators and supervisors of ceramic plants, management education on plant managers, training for art-ceramic engineers of small enterprises, training for assessors of ceramic plants, seminars on corporate R&D staff, and technology diagnosis of small enterprises at the small enterprise center.

Official certifications consist of the following:

Diploma 1 (D1): Persons who have completed this course receive D1 Certification on Ceramics. 30 persons have completed the course each year since 1991.

Diploma 2 (D3): A three-year course that was started in 1992, held jointly with General Ahmad Yani University. Persons who have completed the course receive D3 Certification on Ceramics.

6.1.2.5 Publication activities

BBK publishes semi-scientific magazine "Ceramic & Glass Technology Information (Informasi Teknologi Keramik dan Gelas)" quarterly. It also publishes biannual scientific magazine "Journal of the Indonesian Ceramic and Glass" to disseminate R&D results and technical information.

6.1.2.6 Record of research and development on ceramic materials

According to BBK's record of research and development activities related to ceramic material conducted during the recent three years (1992-94) (see Table 6-2), 3 projects were carried out in 1992, concerning properties of chromite, kaolin-based clay, and clay, and their processing methods; 2 projects covering properties of feldspar and clay and their processing methods in 1993; and one project on the use of locally available feldspar in 1994. The average research budget per project amounted to Rp 7 million - 8 million (350,000 - 400,000 yen) with duration of one year and 6 staffs. Ceramic material testing service handles 500 samples each year.

6.1.2.7 Ceramic material-related research and development plans (96-98)

Major research and development projects planned by BBK include the effective use of ceramic materials and locally available materials, the establishment of Ceramic Raw Material Testing Laboratory approved by National Accreditation Committee, and collection of data on properties of ceramic materials and their storage. In addition, education of experts and upgrading or introduction of testing equipment are being planned

as part of efforts to reinforce R&D capabilities, but their implementation is difficult because of budget restraint.

6.1.3 Budget

Comparing BBK's budget (A) during the past three years and budget (B) related to research and development on ceramic materials and products (Table 6-3), the former increased 44% during the three-year period from approximately Rp 1,000 million to Rp 1,440 million. On the other hand, budget (B) nearly doubled from Rp 290 million to Rp 570 million, indicating the budget item receives high priority under general budget restraints. The amount of the 1994 budget per research staff is Rp 7 million (approximately 350,000 yen), which is far below financial requirements for facility improvement, and the procurement and upgrading of testing equipment.

6.1.4 Facility and equipment

BBK's facility site has land area of 14,910m^2, on which ten buildings are located, with total floor area of 8,538m^2. The list of existing equipment is shown in Table 6-4. The present condition of major equipment is described as follows.

(1) Chemical analysis

BBK owns a variety of equipment for chemical analysis including UV Spectrophotometer, AAS, a flame photometer, a X-ray fluorescence spectrometer, which are calibrated every month. Nevertheless, most of them are relatively old having been procured between 1974 and 1982. All the balances, the most basic weighing scale for chemical analysis, are of direct-reading type, and BBK has no electronic balance with high efficiency. Also, the balances are kept in chemical analysis rooms where precision equipment may be eroded by chemicals vapor giving damages or affecting precision levels, so that they should be isolated from such corrosive environment by separating measurement rooms from those for analysis. In particular, draft chambers in analysis rooms are natural convection flow type, allowing harmful vapor to flow into the room. These are unthinkable in modern chemical analysis. This indicates the need not only for upgrading analytical equipment, but also retraining of analytical engineers.

Analysis of chemical components of raw materials is conducted by the gravimetric method by burning them with gas in a platinum crucible. However, gas burning results in poor accuracy levels of analysis, as the number of platinum crucibles is limited to hinder efficient analysis. While the X-ray fluorescence spectrometer is capable of

performing quantitative determination of raw chemical components quickly and in large quantities, the model owned by BBK was manufactured in 1980. Because of old equipment, content of each element is manually calculated by comparing its characteristic fluorescent X-ray peak with that of a standard specimen. As a result, analysis takes a relatively long period of time, with less accuracy. Since the most frequently requested tests are chemical analysis of raw materials, the upgrading of the X-ray Fluorescence spectrometer a little earlier is desirable for streamlining analytical work with better accuracy. It is required to obtain additional crucibles and a high performance electric furnace.

(2) Micro-structure test

BBK owns a X-ray diffractometer, a SEM, and an IR spectrometer, which were procured in 1978, 1982, and 1983, respectively. Among them, the X-ray diffractometer is essential in analyzing crystal structure of ceramic raw materials. The existing equipment can be used even if it is old type.

(3) Thermal analysis

BBK has a large number of equipment related to thermal analysis, including DTA/TGA. However, DTA is more than 20 years old (purchased in 1973) and other equipment are generally old. Because DTA/TGA is essential equipment to know thermal characteristics of ceramic raw materials, it is recommendable to be renewed.

(4) Optical test

A wide variety of optical testing equipment including microscopes is available. But Polarizing Microscope and Binocular Stereo Microscope cannot give clear picture, because they are old and not well maintained. They are also to be renewed.

(5) Mechanical test

BBK has 5 models of strength testers, of which 2 are currently unserviceable.

(6) Physical test

Physical testing is required for testing final products including ceramic building materials. BBK has 23 types of physical testing equipment, accounting for the largest percentage of existing equipment stock. However, the abrasion tester and the Vickers hardness tester are unserviceable. Since these equipment are not owned by private companies, quick repair and replacement are recommended.

Note that the above equipment 6 are all foreign made, e.g., Japan and Germany, and are not well maintained. Since it is difficult to obtain spare parts for foreign-made equipment, reliable standards for daily inspection and maintenance need to be established and followed faithfully in field. Then, as new equipment is obtained in future, consideration should be given to structure and environment of the room accommodating the equipment, together with training of engineers and technicians who will use it. Also, it is important to create clean laboratory environment to ensure health of research staff.

6.1.5 Technical cooperation

6.1.5.1 Technical cooperation with foreign organizations

BBK has been conducting joint research projects and exchanging research staff with National Industrial Research Institute of Nagoya in Japan and the Institute for Transport of Industrial Technology (ITIT).

6.1.5.2 Technical cooperation with domestic organizations

BBK conducts joint research projects with PPPTM (Pusat Penelitian dan Pengembangan Teknologi Mineral, the Mineral Technology Research and Development Center: MTRDC) under the Ministry of Mining and Energy and DSM (Direktorat Sumberdaya Mineral, Directorate of Mineral Resources: DMR), in the field of energy saving technology using coal for firing brick and tile as well as research on ceramic materials. Other joint research projects include the following.

- With Directorate General of Multi Various Industry: Manufacture and design of medium- and high-tension insulators; and assembly of universal testing machines for timber's tension strength, compression, and bending.
- With Directorate General of Small Scale Industry: Staff training and quality control for small factories; the design of common service facilities; and development of materials for white porcelain low-tension insulators.
- Inception and promotion of a mutual cooperation project between the construction material industry and the construction industry for Perum Perumnas (National Low Cost Housing Development).
- Staff training for ASAKI (Indonesian Ceramic Association)
- Joint development with Directorate for Building Research of a lime kiln using a Sobek-type flameless burner
- Modification of Hoffman kiln with PT. Super Bata Bricks Manufacturing
- Joint development with PT. Krakatau Steel Industry of a method for renovating

refractories used for lining of melting furnaces at small metal shops

- Joint technical diagnosis and resource survey with regional offices of the Ministry of Mining in South Kalimantan, West Nusa Tenggara, Aceh, Bali, West Java, Central Java, and East Java
- Joint development of the production methods for high-tension insulators with BPPT (Agency for the Assessment and Application of Technology)
- Joint investigation and research on suitability of glaze materials with PT. Radian

Thus, BBK is conducting joint research projects with various public research institutes and private enterprises. It is recommended that BBK will step up these joint efforts for the purpose of improving technology levels and disseminating new technology on a continuous basis. Moreover, it is desirable to organize these collaborative relations into workshops, then to an official organization like an academic society. As for technical cooperation with foreign organizations, BBK needs to reinforce its efforts, under budget restraint, by focusing on particular areas where technology of local industries needs to be upgraded. Important activities related to ceramic materials subject to this study are the mapping of locally available resources usable as ceramic materials and a data bank system covering raw materials. In particular, the data bank system covering ceramic raw materials is being built up by three organizations, BBK, MTRDC and DSM under the Ministry of Mining and Energy, which are responsible for the following areas:

Organization and function of Data Bank for ceramic raw material reserve

(Institution)	(Main are to be covered)
BBK:	R/D of Ceramic Production
	R/D of Processing of Ceramic Product
	F/S of Ceramic Industry
	Training of Ceramic Industry Staff
	Distribution of Technology and Technical Information
	Production and Quality Control System
	R/D of Waste Material from Ceramic Processing
MTRDC:	Design/Engineering of Mining Equipment
	F/S of Process and Processing for Mining
	Exploration of Raw Material
	Analysis of Environment (Eco-System)
	Beneficiation of Raw Materials
	Handling of Raw Material

DSM: Mapping of Raw Material
Testing of Raw Material
Potential of Raw Material Resource

6.2 The Mineral Technology Research and Development Center (MTRDC)

(Pusat Penelitian dan Pengembangan Teknologi Mineral: PPPTM)

6.2.1 General

The Academy of Geology and Mining and the Metallurgy Research Center, both of which had conducted since 1960, were merged into the Mineral Technology Development Center (MTDC) under Ministerial Ordinance No.548 of the Ministry of Mines and Energy in 1976.

MTDC was reorganized under Ministerial Ordinance No.132 (1979) and No.1092 (1984) to a lower branch of Mines and Energy Department that was under direct supervision of Mine Director General, responsible for management in the development of mining technology. Under Ministerial Ordinance No.1748 (1992), MTDC was divided into the Mineral Technology Research and Development Center (MTRDC) and the Manpower Development Center for Mines (MDCM).

As shown in Figure 6-2 MTRDC consists of Administrative Division, Mining Technology R&D Division, Mineral Production Technology R&D Division, Coal Utilization Technology R&D Division, Mining Engineering and Design R&D Division, and Mining Information/Technology/Economy R&D Division, each having function groups.

MTRDC has a total of 460 employees (Table 6-5). Breakdown by educational background is 143 university graduates, 55 academy (three-year college) graduates, and 262 with high school or lower levels of education. Among university graduates, 6 have Ph.D and 28 master's degree, making MTRDC an organization staffed by highly educated people. By area of specialization, mining engineers are the largest in number, followed by geologists, chemical engineers, and chemistry. The study evaluated Mineral Production Technology R&D Division, which consisted of 98 staffs led by division head, accounting for 20% of total. The division is divided into Physical/Chemical Testing Section (18 staff), Mining Industry Production Technology Testing Section (10), Metallic Mineral Production Technology Testing Section (8), Material Technology Testing Section (8), Function Group (37), and administrative staff (17).

6.2.2 Activity description

6.2.2.1 R&D activities

Research and development on technologies related to strip mining, underground mining, mining geomechanics, exploration, safety and health, and mining reclamation, and guidance on mining technology; physical testing and chemical analysis of mineral samples; research and development on raw materials, metallic menials, and industrial processing technology; service related to mineral processing technology and environmental analysis; research and development on coal and peat combustion and conversion technologies; physical testing and chemical analysis of coal and peat; research and development on mining and environmental technologies, mineral engineering, and design and simulation of process control; collection and assortment of R&D results related to economy of mineral resources, feasibility study on the mining industry, the mineral market, and processing and disposal of mineral resources; and management of mineral information, record, and publication.

6.2.2.2 R&D topics in 1992/93

- Research on properties of coal, minerals, and rock in relation to production and utilization technologies; research on technology related to concentration, quality improvement, refining, and utilization of industrial minerals including bentonite, kaolin, quartz, feldspar, sulfur, phosphate, limestone, dolomite, pumice, jarosite, zircon, and bauxite; and research on technology for classification, refining, and production of metallic minerals including Au, Ag, Fe, Sn, Pb, Cu, Zn, Ni, Co, Cr, and Mn.

- Joint research on energy saving technology based on coal fuel for large enterprises, including metal smelters, cement mills, and thermal power plants, and small enterprises in kaolin drying, iron smith, lime, sanitary, rooftile, and brick.

- Development of production technology by using pilot plants, including production of Au and Al, lime baking by coal, production of light lime, tableting of iron sand and its quality control, manufacture of magnesium oxide by using sea water and dolomite, activation of coke, zeolite, and bentonite, and production of silica powder; technological development, design and engineering by using verification plants, including production of Au, extraction of sulfur, activation of bentonite and zeolite, baking of lime, production of hydrated lime, and processing lead ore; development, design and engineering related to mining equipment and mineral processing technology, including trammel, vibration screen, belt feeder, classifier, jig, shaking table, and reaction tank; sampling, physical testing, and

chemical analysis of minerals, water, soil, and air; development, design and engineering of briquette producers, cooking stoves, lime baking furnaces, and brick and time heating furnaces; improvement of production efficiency of gold and lead manufacturing plants; analysis of problems related to production technology at manufacturing plants; environmental impact analysis and preparation of environmental monitoring plans; training for outside persons concerning testing, analysis, and production method for minerals; research on processing methods for metals, non-metallic minerals, and coal, and mining technology; research on water analysis in industrial areas and mines, and the method to increase valued added by metallic and non-metallic minerals; application of monitoring technology to gold mines in West Java, nickel mines in Southeast Sulawesi, and copper mines in Irian Jaya; construction of a pilot plant in West Sumatra for a brick/roofing tile baking furnace burning coal; construction of a pilot plant in West Java for mining and processing of silica sand, andesite, and zeolite; construction of a pilot plant in Central Java for mining and processing of bentonite; construction of a pilot plant in West Kalimantan and North Sulawesi for mining and processing of gold; and a pilot plant in Doi Island for mining and processing of manganese ore.

6.2.2.3 Mineral material refining technology development projects in 1995-97

The project is being planned as a five-year project starting in 1995. Research topics and locations for two fiscal years of 1995/96 and 1996/97 (Figure 6-3) are summarized as follows. In 1995/96, a total of 15 projects is planned, concerning the improvements of quality of raw materials, refining method, and R&D equipment for improvement of refining technology. Among then, three projects are related to the project, namely the improvement of the feldspar refining method, the improvement of quality of Pozolan cement in West Java, and the development of equipment for improvement of the feldspar refining method.

In 1996/97, 6 projects will be added to total 21 projects, concerning the improvements of quality of raw materials, refining method, and R&D equipment for improvement of refining technology. Three projects related to this study will be scaled up, and a research project on the refining method of East Timor clay will be started in order to use it for earthware.

6.2.2.4 Research topics of Mining Production Technology R&D Division in 1995/96

Mining Production Technology R&D Division plans a total of 15 research topics for 1995/96. 6 projects are related to ceramic material: Research on technology to extract alumina from kaolin in South Sumatra; research on technology to refine silica stone in Central Java for fine ceramics; research on method to extract magnesium oxide from

dolomite in East Java and sea water; research on technology to use ball clay in Central Sumatra; and research on technology to use pottery stone in East Java.

6.2.2.5 Publication activities

MTRDC publishes the results of R&D projects related to mineral resources by a variety of media including reports, bulletins, MTRD's News, brochures, and leaflets, and hold exhibitions in an attempt to disseminate technical information related to mineral resources. Previous publications include 72 reports on preservation of minerals and analysis of coal storage in Java, Sumatra, and Kalimantan; 30 reports on economic evaluation of minerals in Java, West Nusa Tenggara, East Nusa Tenggara, and Kalimantan; 12 report on minable strata and extent; 13 reports on optimization of use of minerals in Java, West Nusa Tenggara, East Nusa Tenggara, and Kalimantan; 155 issues of MTRD's News; 57 issues of MTRDC Bulletins; and 59 brochures on metallic and non-metallic minerals and coal.

6.2.3 R&D facilities and equipment

MTRDC has the following laboratories:

Mineralogy laboratory: Identification of minerals by using optical microscopes, X-ray diffraction analyzer, and scanning electronic microscope, and texture analysis of mine ore by separation, ore properties, and quantitative analysis.

Physical/chemical laboratory: Analysis of mineral elements and chemical composition by using an atomic absorption photometer and wet analysis, and analysis of water, soil, and gas for analysis of environmental problems related to mines

Mineral processing laboratory: Conducting gravity concentration test, floating concentration test, magnetic concentration test, and semi-continuous electrostatic test.

Extractive metallurgy laboratory: Conducting heat extraction test, water extraction test, electro-extraction test, and bio-extraction test.

Environmental metallurgy laboratory: Treatment of water, soil, air, and waste treatment methods and equipment design

Plant design/engineering laboratory: Mineral extraction and processing on an industrial scale, and plant design

Coal laboratory: Preliminary and detailed analysis, research on coal utilization method, and research on coal utilization technology

Mineral processing and metallurgy pilot plant laboratory: Continuous production system test, tableting test, and ferro-/non-ferrous solution test

Production method simulation laboratory: Computer-aided design of mineral processing method, simulation of assumed processes, and equipment design service

Mining laboratory: Mechanical and physical test on soil and rock, and mine design and simulation test

International database retrieval: Using Dialogue (U.S.) and Questel (French) databases

Geographical information system: Use and development of the system

Among them, the study team investigated Mineral Producing Laboratory and Mineral Processing/Metallurgy Pilot Plant Laboratory that has close relations with Mineral Production Technology R&D Division. They are located on different floors (1st and 2nd), with floor area of 300m^2 each.

The both laboratories appear to have sufficient testing environment in terms of lighting, space, and equipment layout. Large equipment in the pilot plant laboratory on the first floor, although not in operation, seems to be in good condition. Some of equipment in the mineral processing laboratory on the second floor, including ball mills, classifiers, and electrical furnaces, are outdated and require upgrading.

6.2.4 Technical cooperation

6.2.4.1 Technical cooperation with foreign organizations

Japan: Research on utilization method for zeolite (Tohoku Research Institute), research on cement materials (National Industrial Research Institute of Nagoya: NIRIN), and research on sulfide minerals (Japan Society for the Promotion of Science: JSPS)

Korea: Research on coal tabulation (Energy and Resources Research Institute), and research on titan oxide extraction technology (Industrial Science and Technology Agency)

Austria: Research on tracing elements and toxicity contained in coal (International Nuclear Energy Agency)

Australia: Sending staff to many universities for post-graduate study

England: Equipment in cola laboratory (U.K. mining consultant) and research on mineral and coal mining and processing technologies (university)

The U.S.: Research on utilization method for low-grade coal and sending staff to universities for post-graduate study

In addition, MTRDC conducts cooperation with research organizations in other countries including Sweden, the Netherlands, France, and Germany.

6.2.4.2 Technical cooperation with domestic organizations

Joint research projects related to mining, processing, and utilization technologies are carried out with a number of public research organizations and universities, including Indonesian Institute of Science (LIPI), the Agency for Assessment and Application of Technology (BPPT), Directorate of Mineral Resources (DSM), BBK, Padjadjara University, Bandung Institute of Technology (ITB), Nusantra Islamic University, Bogor Agricultural Institute, Veteran National Development University, and Veteran Sriwijaya University.

In the fields of evaluation, collection and compilation of data and information, collection and compilation of industrial mineral data is conducted in collaboration with a central statistics bureau, local statistics bureaus, industrial sections, commercial sections and mining offices, and Regional Planning and Development Agency (BAPPEDA).

Electronic data storage using computers is progressed under cooperation with directorates under Directorate General of Mines, local offices of Directorate of Mining and Energy, local mining offices, and enterprises owned/controlled by states.

Information exchange covering scientific and engineering literature is conducted with LIPI, Indonesian Scientific Document Center (PDII), National Mining and Geology Institute (LGPN), BPPT, BBK, and universities mentioned above.

Thus, MTRDC is actively involved in technical cooperation with many public research organizations and universities, both domestic and overseas. It seems to have sufficient R&D capacities and have achieved successful results in upgrading and dissemination of

technology. One problem is that it does not maintain collaboration with private enterprises, except for via BBK.

6.3 Directorate of Mineral Resources (DMR)

(Direktorat Sumberdaya Mineral: DSM)

6.3.1 General

DSM was established in 1992 under Decree No.1748 of the Department of Mines and Energy, which was issued in response to Presidential Decree No.67 issued the same year. It is one section of Directorate General of Geology & Mineral Resources of DME. DSM's mission is to promote exploration and commercialization of mineral resources in Indonesia.

DSM consists of six divisions (Figure 6-4), Metallic Mineral Exploration, Industrial Mineral/Rock Exploration, Coal/Peat Exploration, Geophysics/Drilling Exploration, Geochemical/Mineral Information, and General Administration. All the divisions except for General Administration consist of 4 sections each.

DSM has 678 employees as of 1994 (Table 6-6), of which 254 belong to administrative units, and 233 R&D units, and 191 in measurement and exploration technology units. By field of specialization, there are 121 geologists, 51 mining engineers, 41 chemists, 10 geophysicists, 4 geodesicists, and 6 mathematicians and statisticians. Thus, DSM is a research organization dominated by geologists, mining engineers, and chemists. By job description, there are 233 researchers, 51 meteorologists, 40 exploration (boring) and related engineers and technicians, and 254 managers and administrative staff.

6.3.2 DSM's activities

6.3.2.1 DSM's functions

DSM's major functions are as follows:

- Investigation and evaluation of reserves of metallic minerals, industrial minerals, coal, and peat, and their mapping;

- Production, analysis and evaluation of reserve data on various resources, and collection of modified data;

- Planning and implementation of geophysical and geochemical exploration projects;

- Publication of geological, geophysical, and geochemical maps on mineral resources in Indonesia;

- Development of an Indonesia mineral information system;

- To conduct physical and chemical analysis tests on mineral resources; and

- To provide technical service and conduct technical training for companies.

6.3.2.2 R&D activities

DSM's R&D activities are as follows:

- To conduct exploration and research on reserves of metallic minerals, industrial minerals, coal, and peat;

- To plan and implement detailed geochemical surveys in regions;

- To plan and implement geophysical drilling surveys;

- To implement physical and chemical analyses of collected samples;

- To publish and disseminate exploration data and latest information on mineral resources; and

- To provide education and training related to exploration technology for private enterprises and public organizations doing exploration.

6.3.2.3 R&D activity results

(1) Mineral resource reserves

Since PELITA-1, activities related to exploration of mineral resources and preparation of mineral lists have progressed rapidly. Mineral resource reserves proved as of 1992 (Table 6-7) are limestone 28.8 billion tons, coal 20.5 billion tons, peat 18.1 billion tons, granite 10.2 billion tons, marble 8.6 billion tons, quartz sand 4.6 billion tons, clay 2.7 billion tons, andesite basalt 2.6 billion tons, and feldspar 2.5 billion tons.

(2) Mineral resource data and information

The results of mineral resources exploration and mineral inventories have been published in numerous reports and maps, which can be obtained from DSM's library. These publications have been made available to the public at various occasions including seminars and exhibitions. Major publications include the following:

・Mineral resources maps

The following resource maps in Indonesia have been prepared (all on a 1/5,000,000 scale) and made available to the general public: Coal and Peat Resources Map; Gemstone Distribution Map; Industrial Minerals and Rocks Distribution Map; Metallic Minerals Distribution Map; Detrical Metallic Minerals Distribution Map; Gold Deposits and Occurrences in Their Indonesia Geological Setting Map; Iron and Ferro Alloy Metallic Minerals Distribution Map and Base Metal Minerals Occurrences Map.

・Special publications

45 special publications including the following have been published: "Mineral Exploration Report as a System"; "Exploratory Note on Coal Resources Map of Indonesia"; "A Consideration Mineral Resources Classification from the Mineral Mining Activity"; "Suggest Mc Kelvey in Correlation with Indonesian Social Economic Aspect"; "System Planning of Inventory and Information of Mineral Resources"; "Methods and Techniques of Geochemical Exploration Stream Sediment"; "Type/ Characteristic/ Occurrences/ Utilization of Clay/ Zeolite/ Dolomite/ Magnesite"; "Coal Resources in Central Sumatra"; "Coal Petrographic Analysis Procedure of Indonesian Coal Samples"; "Basic Gravity Computer Programme"; "Prospect and Industrial Potential of Calcium Carbonate in Indonesia"; "The Mineral Resources in Southern West Java"; "Methods and Techniques Used in The Southern Sumatra Geochemical Mapping Programme"; "A Report on the Geochemistry of Stream Sediment Samples from the Padang Quadrangle Southern Sumatra"; "Industrial Mineral Series 1"; and "Industrial Mineral Series 2."

・Sumatra regional multielement geochemical maps

Distribution maps on Cu, Pb, Zn, Co, Ni, Mn, Ag, K, Li, Cr, As, Sn, and Mo in the following areas of Sumatra: Lhokseumawe, Banda Aceh, Langsa, Calang, Takengon, Lubuk Sikaping, Tapak Tuan, Sidikalang, Pematang Siantar, Sibolga, Medan, Tebingtinggi, Rengat Painan/ Muara Siberut, Muarabungo/ Jambi, Sungai Penuh/Ketaun, Manna, Palembang Lahat, Sarolangun, and Bengkulu. All of the maps are on a 1/250,000 scale.

As shown above, DSM's main responsibility lies in exploration of mineral resources within the country, estimation of their geographical distribution and reserves, and reporting and mapping of these results. Therefore, to accurately assess ceramic resource conditions in possible sources, DSM's data and survey results are crucial.

6.3.3 DSM's facilities and equipment

6.3.3.1 Testing facility

DSM uses a five-story building as its testing laboratory. Each floor has approximately 500m^2, totaling 2,500m^2 for the entire building. Each laboratory room is partitioned by panels having transparent acryl resin windows to give a whole view of laboratory rooms on each floor and to provide sufficient natural light. Interior decoration and fixture are new, and rooms are well air-conditioned and provide ample space. All in all, these laboratories are very modern facilities.

6.3.3.2 Laboratories and equipment

The facility consist of three laboratory departments, Mineral Chemical Laboratory, Mineral Physical Laboratory, and Geology and Exploratory Drilling Laboratory. Each department is divided into several laboratories as follows.

(1) Mineral Chemical Laboratory

- Sample Preparation Laboratory

The laboratory is responsible for preparing samples of sediments, rocks, panned concentrates, mud, ores, clay, coal, and peat which are to be used by other laboratories for testing purposes.

- Instrumental Laboratory

The laboratory conducts qualitative and quantitative analyses of minerals by using a X-ray diffractometer, and quantitative analysis of main elements of minerals by using a X-ray fluorescence analyzer.

- Geochemical/Metal Analysis Laboratory

The laboratory conducts geochemical analysis of samples obtained from geological surveys and chemical analysis of metal elements including Ag, Al, Au, As, Ba, Bi, Cd, Ca, Cr, Co, Cu, Eu, Gd, Fe, K, La, Li, Pb, Mg, Mn, Hg, Mo, Na, Ni, Rb, Sb, Sm, Sr, Sn, Ta, W, V, Yb, Y, Zn, Zr, by using atomic absorption spectrometers (AASs).

- Wet Analysis Laboratory

The laboratory conducts physical and chemical analyses to determine physical properties of samples and major elements consisting of samples. Typical examples are shown below:

Name	Major Elements/ Test
Silicate rock:	SiO_2, Al_2O_3, Fe_2O_3, FeO, CaO, MgO, Na_2O, K_2O, TiO_2 SO_3, P_2O_5, H_2O^-, H_2O^+, LOI, Organic matters
Limestone:	CaO, MgO, LOI, SiO_2
Quartz:	SiO_2, Fe_2O_3, Al_2O_3
Phosphate:	P_2O_5, CaO, SiO_2
Ore:	Fe_2O_3, TiO_2 (by ore samples)
Physical properties:	Drilling mud, Bleaching test, Methylene blue test cation exchange capacity, etc.

For chemical analysis, 4 AASs and a inductively coupled plasma emission spectrometer (ICP) are used. In particular, the ICP was procured last year (1995) under JICA's assistance. A chemical analyst sent by JICA is providing technical assistance related the use of the ICP for two years. It is expected that DSM's ability in chemical analysis of mineral resources will progress significantly a year later. In addition, a geologist sent by JICA is providing technical assistance for the geological survey division.

- Coal & Peat Laboratory

The laboratory conducts analysis of coal and peat, covering the following items:

Name	Analytical items
Proximate analysis:	Moisture content, Ash content, Matter fixed carbon
Ultimate analysis:	C.H.N.
Others:	Form of sulfur, Calorivic value, Hard grove index swelling index, Abrasion index, Specific gravity appearance relative density, Ash fusion (oxidation and reduction)

(2) Mineral Physical Laboratory

- Sample Preparation Laboratory

A cutting machine and a grinding machine are used to process than film samples for coal and heavy minerals.

- Physical Analysis Laboratory

The laboratory conduct physical analysis of minerals, including mineralogy (heavy metals, precious metal), grain analysis (type, size, weight), petrographic, mineragraphic (microscopic metal minerals), coal maseral (type and coal quality), fluid inclusion and ash fusion.

- Instrumental Laboratory

For physical analysis, the laboratory has binocular microscopes, polarization microscopes; hating stages, and heating microscopes (2-4 units each). A higher level of R&D activity is facilitates if a scanning electron microscope and an electron probe X-ray microanalyzer (EPMA) are added.

(3) Geology and Exploratory Drilling Laboratory

Reserves of coal and peat are estimated by relying on geophysics and drilling technologies and using the following equipment:

- Geoelectric and Logging Equipments
  - I P Equipments (3 Units)
  - CSAMT (1 Unit)
  - Resistivitimeter (5 Units)
  - Drill Hole Logger (2 Units)
- Seismic (2 Units)
- Gravimeter and Magnetometer
  - Gravimeter: Lacoste & Romberg (3 Units)
    G-422 & G-520
    Worden 874-122 (3 Units)
    GEM-8
    Mc Phar.
  - Magnetometer: Proton Magnetometer Geometric (8 Units)
    Geometric 6136-G816
    Elsec Proton 592/499.

- Drilling Equipments.

16 drilling machines (10 types) (Table 6-8) are also available for a wide range of activities.

6.3.4 Technical cooperation

6.3.4.1 Technical cooperation with foreign organizations

DSM is conducting joint research projects with research organizations in various countries, including the following:

The U.S.:	Education and training for professional engineers and technicians
Belgium:	Reconnaissance survey and mineral exploration in West Kalimantan
The U.K.:	Geological, geochemical, and geophysical exploration project in Sumatra
Germany:	Reconnaissance survey in precious, base, and ferro alloy metals
Japan:	Exploration of metallic minerals in Sulawesi, Kalimantan, and Sumatra
France:	Geological mapping and geochemical exploration in East Kalimantan
Sweden:	Biogeochemical exploration to prospect mineral reserves
New Zealand:	Bentonite resource survey in Java
South Korea:	Base metal resource survey in East Java and Pacitan

6.3.4.2 Technical cooperation with domestic organizations

DSM, in collaboration with BBK and MTRDC, is building a data bank system related to ceramic materials, mainly responsible for the mapping and testing of raw materials, and assessment of mineral resource potential.

DSM is conducting joint research projects with MTRDC concerning mineral resource exploration technology and equipment. Also, it provides technical guidance for state-owned mining companies to improve their ability in exploration of mineral resources.

Thus, DSM is actively involved in technical cooperation covering many research organizations, both locally and internationally, and has sufficient R&D resources to support them. On the other hand, its testing and inspection resources as technical infrastructure for development of the ceramic industry needs to be reinforced by combining

capabilities and resources of three research organizations under the Department of Industry, namely BBK and regional research institutes in Sumaran and Surabaya, and DSM and MTRDC under the Department of Mines and Energy.

6.4 Geological Research and Development Center (GRDC)

(Pusat Penelitian dan Pengembangan Geologi: 3PG)

6.4.1 General

3PG was established under Decree of Department of Mining and Energy No.1092 issued in 1984, as an organization responsible for research and development in the field of earth science and reporting to Directorate General of Geology and Mineral Resources. Its major duties include assessment and evaluation of mineral resources, prospecting and exploration, research and study on environmental issues, dissemination of technical information in the fields of geology and geophysics, and promotion of earth science.

3PG's organization (Figure 6-5) is based on Department Decree No.1745 of 1992, consisting of 6 divisions, Geological Mapping, Geophysical Mapping, Geology, Quaternary Geology/Seismotectonic, Publication/Information, and General Administration. All the divisions except for general administration have functional groups. Each division consists of 4 departments.

3PG has 420 employees as of 1994 (Figure 6-6). By academic background, there are 13 Ph.D holders, 55 holds master's degree, 123 have bachelor's degree, 15 are academy graduates, and the remaining high school graduates or lower. Thus, 3PG's employees are highly educated. By field of specialty, 3PG employees 119 geologists, 26 geophysicists, 49 senior engineers, and 49 design engineers, and 15 engineers, making it a specialty R&D organization dominated by geologists and geophysicists.

6.4.2 Activities

6.4.2.1 3PG' functions

3PG is largely responsible for exploration of mineral and energy resources, collection of basic data to identify geologically hazardous areas and areawide environmental change for environmental preservation purposes, and collection of basic data contributing to the development of earth science, based on which it produces systematic geological and geophysical maps covering the entire country. These geological and geophysical maps depict detailed subsurface conditions, including geological structure, rock formations and their ages, size, shape, including mineral and energy resources. These maps are also used

by various sectors including factories, communication, public works, and transportation for safety and maintenance purposes, while providing technical information for environment and development sectors.

6.4.2.2 Activity results

(1) Geological mapping

Geological maps, produced by Geological Mapping Department, are basically constructed on a two-dimensional basis by using field data, and show rock description and shape by various symbols. 3PG plans to map the entire country by using 1/100,000 maps for Java and Madura, and 1/250,000 for other areas. At the beginning of 1994, 58 grids covering Java and Madura were all mapped, and 162 out of 181 grids (89.5%) for other areas. In addition, regional maps on 1/1,000,000, 1/2,000,000, 1/5,000,000 scales are being constructed. Among them, 1/5,000,000 maps have been completed, with 14 out of 16 grids (87.5%) completed. The remaining maps will be completed within the PELITA 6 period, and 3PG is now planning to produce 1/50,000 maps for selected areas in Java and Madura, and 1/100,000 maps for other important areas.

(2) Geophysical mapping

As for gravity maps, 1/100,000 maps plan to be produced for Java and Madura, and 1/2,500,000 maps for other areas. At the beginning of 1994, 50 out of 58 grids (86.2%) were completed for Java and Madura, and 77 out of 181 (42.5%) for other areas. For 1/1,000,000 maps, 10 out of 16 grids (62.5%) have been completed.

(3) Thematic mapping

3PG is preparing thematic maps for selected areas, consisting of 1/50,000 geological maps, 1/100,000 geomorphologic maps, and 1/250,000 seismological maps. Thematic maps are designed to provide technical information useful for identification of earthquake damage, environmental and other monitoring, protection, and regional development.

Quaternary geological maps show distribution and structure of rocks/reserves in layers sedimented from the Quaternary Age (2 million years ago) to date.

Geomorphologic maps show the results of topographic analysis, surface sedimentation, and distribution of geomorphologic and land use units.

Seismological maps depict distribution of rocks easily affected by earthquake, seismic profiles, pattern and distribution of geological structure, distribution of epicenters producing major earthquakes of 7 or larger on the Richter scale, by magnitude and depth.

Table 6-9 summarizes systematic/thematic maps produced by 3PG.

(4) R&D activities

3PG is conducting environmental research to solve geological issues in selected areas by applying various methodologies. Also, it is conducting and reinforcing research and development projects in the areas of tectonic evolution, magmatic evolution, stratigraphy, quaternary geology, geomorphology, seismology, and specific geophysical problems, by applying a wide range of methods and techniques, including petrology, mineralogy, paleontology, geochemistry, geodynamics, geochronology, remote sensing, gravity, magnetic electromagnetic, paleomagnetic, seismic, and rock physics.

(5) Publication/information

3PG publishes science and engineering reports in a variety of forms including magazines, map explanatory notes, special publications, bulletins, annual reports, mineral resources reports, paleontology series, geophysical series, geological newsletter, and journal of geology. Through these media, it intends to disseminate technical information on mineral resources for educational purposes.

6.4.3 Facilities and equipment

3PG has two laboratories, one within its headquarters and another located 10km therefrom, Quaternary Geology Laboratory.

Testing equipment (Table 6-10) includes an electronic scanning microscope, X-ray diffraction equipment, a differential thermal analyzer, binocular microscopes, polarization microscopes used to analyze mineral structure and composition; an electron probe microanalyzer for chemical analysis of micro-parts of minerals; radio carbon dating, fission track dating, and potassium argon dating equipment to determine ages of minerals; atomic absorption analyzers, mass spectrometers, and flame photometers for chemical analysis of minerals; seismographs to record earthquake; cartographic equipment for map production; deep well machines to collect rock samples, and shallow well machines. At the headquarters' laboratory visited by the study team, these testing equipment is kept in good conditions and is sufficiently serviceable, excepting some old equipment.

6.4.4 Technical cooperation

6.4.4.1 Technical cooperation with foreign organizations

3PG is conducting technical cooperation projects aiming at human resources development, with research organizations in a variety of countries including Australia, Belgium, the U.K., Japan, the Netherlands, New Zealand, France, Germany, and the U.S.

6.4.4.2 Technical cooperation with domestic organizations

3PG is maintaining collaborative relationships with government research organizations in the areas of technology, efficiency, and human resources development.

The above analysis indicates that not much benefit can be obtained from incorporation of 3PG into the contemplated testing and inspection system that serves as technology infrastructure for development of ceramic materials.

Therefore, the proposed testing and inspection system should be organized by BBK, Semarang Research Institute, and Surabaya Research Institute under Department of Industry, DSM and MTRDC under Department of Mines and Energy.

6.5 Laboratory and Testing Institute for Industrial Products Semarang (LTIIPS)

(Balai Penelitian dan Pengembangan Industri Semarang: BPPIS)

6.5.1 General

BPPIS was established in Semarang in 1962 as Semarang Chemical Institute. It became a branch of Bogor Chemical Research Institute of a Semarang state corporation "NUPIKSA YASA" under the Ministry of Industry in 1964, and then was reorganized to the present BPPIS under BPPI in 1980.

As shown in Figure 6-7, BPPIS consists of three divisions, Administration, Industrial Development, and Technical Support / Standardization, together with Functional Group, Library / Documentation / Information Unit, and Workshop / Instrumentation Unit. Industrial Development Division consists of four sections, Technical Development / Engineering, Materials / Production / Product, Application, and Technical Economy. Technical Support / Standardization Division consists of Service Support / Monitoring / Technology / Engineering Section, Technical Support / Standardization Implementation Section, Quality Control / Normalization Section, and Guidance / Cooperation Section.

BPPIS has 128 employees (Table 6-11). Their academic background is 31 university graduates, 25 academy graduates, and 72 graduates from high schools or lower schools. By area of specialization, 13 university graduates and 13 academy graduates were majoring in chemical engineering, 4 university graduates in biology, 2 in pharmacology, 3 in agricultural technology, 5 in law, 1 university and 2 academy graduates in chemical education, one university graduate each in economy, sociology & politics, mechanical

education, 5 academy graduates in economy & sociology, and one academy graduate each in chemical engineering, mechanical engineering, and civil engineering.

6.5.2 Activity description

6.5.2.1 R&D activities

BPPIS conducts a variety of activities including research and development on technology and engineering related to industrial materials, sub-materials, production methods, equipment, and products, application of R&D results, evaluation of pollution control technology, economic evaluation of environmental technology, design of iodized salt production equipment, design and drinking water packing equipment, water quality monitoring, and environmental monitoring.

6.5.2.2 Testing and inspection activities

Water and waste: Conducting testing and inspection on water quality, process water, boiler make-up water, cooling water, effluent, waste fluid, solid waste, and waste gas.

Products: Conducting testing and inspection on volatile oil, clove oil, citronella oil, coffee, cocoa, tea, and drink

Building material, metal, mineral: Conducting testing and inspection on concrete, concrete roof, tile, and paving block

Periodical quality control test: Conducting periodical testing and inspection on wine, instant noodle, syrup, noodle, saccharine, chili-tomato sauce, fry oil, soy sauce, cigarette, and soft drink.

6.5.2.3 Training activities

BPPIS conducts training for chemical analysis of products, pollution control technology, and industrial waste and effluent treatment technology.

6.5.2.4 Publication activities

4 technical information magazines, 2 weekly and 2 monthly, are published as part of technical service for private enterprises.

6.5.2.5 Record of R&D activities

BPPIS constructed, jointly with Population and Environment Agency, waste water treatment plants for 5 tofu plants, two in Kebumen, two in Magelang, and one in Semarang, and was responsible for plant design and engineering.

Jointly with PT. Indonesia Miki Industri, it constructed a waste water treatment plant for a noodle factory in Bandung, with responsibility for design and engineering.

It provided technical assistance, jointly with PT. Saritex, for a textile mill in Bandung to improve water quality for a spray chamber.

It was responsible for design and engineering in a joint project with PT. Miki-Moto to build an ammonia gas absorption and removal plant for a sodium cyclamate plant in Bandung.

In addition it was responsible for design and manufacture of waste water treatment plants for a textile mill and a sugar refinery.

6.5.3 Testing facilities and equipment

BPPIS's facility site has land area of 3,637m^2, on which five buildings are located, with total floor area of 2,719m^2. BPPIS has the following laboratories that are equipped with the following testing equipment:

Industrial waste and waste water testing laboratory: Including DO, turbidity, COD, and BOD meters, doncutimeter, PH meter, and incubator oven.

Product testing laboratory: Including Soxhlet extractor, fibriometer, Keeltec auto, cyclotec, refractometer, colorimeter, polarimeter, electrical furnace, centrifugal separator, and vacuum pump

Building material testing laboratory: Including hardness gauge, bending press machine, compression testing machine, universal testing machine, abrasion testing machine, oven, concrete mixer, and cement mixer.

Instrumentation laboratory: Including UV spectrophotometer, total organic carbon analyzer, atomic absorption spectrophotometer, gas chromatography, and shacker

Microbiology laboratory: Including microscope projector, microscope binocular, incubator colony counter, autoclave, and oven.

Gas laboratory: Including noise meter, tube type gas analyzer, H_2S, CO_2 and SO_2 analyzer, and dust sampler.

The study team evaluated Building Material Laboratory which was responsible for testing and research on ceramic raw materials. The laboratory has total floor area of approximately 80m^2, having the above equipment. Testing equipment is outdated but is kept in good condition. Testing environment is good in terms of lighting, space and ventilation. Also, the laboratory is separated from other testing services. On the other hand, there is a shortage of material testing equipment. If new equipment, including a crusher, mixer, classifier, baking electrical furnace, draft, and platinum crucible, are acquired, and existing testing equipment on material strength as well as chemical analyzers at Instrumentation Laboratory are fully utilized, the laboratory can serve as a reliable testing and research organization on raw materials. As for training of experts, the laboratory hires many chemical engineers and will be able to fulfill the function under assistance of BBK.

6.5.4 Technical cooperation

BPPIS does not conduct any technical cooperation with foreign organizations. Although keeping cooperative relationship with BBK, it does not conduct any joint research project with other organizations. In fact, it only receives technical assistance from BBK when any technical problem occurs in the field of ceramics by sending staff.

6.6 Laboratory and Testing Institute for Industrial Products Surabaya (LTIIPSu)

(Balai Penelitian dan Pengembangan Industri Surabaya: BPPISu)

6.6.1 General

BPPISu was originally established in Surabaya as a chemistry research center under the Ministry of Industry. It was relocated to Solo in 1947, then to Yogyakarta in 1950, finally to Surabaya. In 1980, it was reorganized to the present organization under Ministerial Ordinance No. 357/M/SK/8/1989 of the Ministry of Industry.

BPPISu consists of three divisions, Administration, Industrial Development, and Technical Support / Standardization, together with Functional Group, Library / Documentation / Information Unit, and Workshop / Instrumentation Unit (see Figure 6-8). Industrial Development Division consists of four sections, Technical Development / Engineering, Materials / Production / Product, Application, and Technical Economy. Technical Support / Standardization Division consists of Service Support / Monitoring / Technology / Engineering Section, Technical Support / Standardization Implementation

Section, Quality Control / Normalization Section, and Guidance / Cooperation Section.

It employs a total of 113 staff (Table 6-12), who consist of 27 university graduates, 6 academy graduates, and 80 high school or lower school graduates. By job description, there are 39 researchers, 28 engineers, 43 administrators, and 3 assistants.

6.6.2 Activity description

6.6.2.1 R&D activities

BPPISu conducts a wide range of activities, including research on improvement and development of production technology for small- or medium-sized chemical plants and agro-base plants, as well as improvement of material quality; design, regeneration, technical evaluation, and monitoring of industrial waste treatment plants; quality control of metals, building materials, and food and beverage, and research on quality improvement; and analysis of technical issues related to raw materials, production, and product unit processes.

6.6.2.2 Testing and inspection activities

It performs analysis and testing of metal products, building materials, chemical products, dairy goods, food and beverage, waste water, industrial water, drinking water organic materials, grass, crop, vegetable oil, and air pollutants. It also analyzes and tests ceramic materials, including kaolin, dolomite, silica sand, alumina, MnO_2, CaO, MgO, TiO_2, and Fe_2O_3.

6.6.3 Testing facilities and equipment

BPPISu is located on the site covering 10,240m^2, on which there are two buildings. The total floor area is 1,821m^2. Testing equipment performing material testing includes a tension tester, Charpy impact tester, hardness tester, bending tester, pressure tester, micro-hardness tester, ultrasonic flow detector, and X-ray diffractometer. Those performing chemical analysis are an atomic absorption spectrophotometer, gas chromatography, liquid chromatography, carbon-sulfur analyzer, and infra-red spectrometer.

The study team inspected the ceramic material laboratory under this study, The laboratory had floor area of approximately 80m^2. However, it was not clearly separated from analysis and testing areas for organic matters, waste water, and oil, and the facility was not tidy. According to laboratory staff, the laboratory performed analysis and testing on kaolin, dolomite, silica sand, alumina, MnO_2, CaO, MgO, TiO_2, and Fe_2O_3. However, there was only one platinum crucible for baking raw materials. An electrical furnace did

not work and few tests were conducted. The laboratory was not well ventilated due to natural convection draft, and was poorly lighted. Analytical equipment was placed on laboratory tables. Thus, poor management of the laboratory and the lack of consideration to health and safety of workers were at an alarming level.

To make BPPISu fully function as the testing and research organization for ceramic materials, basic equipment including a crusher, mixer, classifier, baking electrical furnace, draft, and platinum crucible needs to be introduced, together with sufficient technical training by BBK's experts.

6.6.4 Technical cooperation

BPPISu has no technical cooperation with foreign research organizations. It maintains cooperative relationship with MIDC in testing metallic materials. As for ceramic materials, it only serves as an intermediary between BBK and its clients.

6.7 Common Service Facility Unit (CSFU)

6.7.1 General

Common Service Facility Unit (CSR) belongs to the Agency for Development of Small-Scale Industries (Badan Pengembangan industri Kecil; BAPIK) of the Ministry of Industry (MCI). In 1982, a plan to establish CSR was proposed for the purpose of providing assistance in the areas of technical development and marketing for small- and medium-sized enterprises related to ceramic production in the Malang district. It rolled out in 1986 and has 17 employees including a director.

6.7.2 Activity description

CSFU's major activities are the supply of raw materials to small- and medium-sized enterprises related to ceramic production in the Malang district and the development of product prototypes.

First of all, CSR is currently supplying complex clay for body and glaze to around 50 small- and medium-sized manufacturers in the district. Complex clay for body is produced at a rate of 40 tons per month, and that for glaze 5 - 7 tons.

These materials have water absorption of 15-20% (one for body) and 40% (one for glaze), and sales prices are Rp 250 and Rp 410 per kg, respectively. They are also supplied to the Bandung district through BBK's cooperatives.

As for prototype development, CSR has staff capable of product design and development. Developed products are mostly novelty goods including ashtray and ornaments. CSR manufactures prototypes upon request of small- and medium-sized enterprises to which CSR supplies raw materials or develops new products on their own to assist small enterprises in product diversification. CSR does not commercialize or sell these prototypes.

6.7.3 Facility and equipment

Major machinery and equipment owned by CSR are as follows:

- Jaw crusher: 1 unit (processing capacity: 400kg/hour)
- Ball mill for body: 3 units (aggregate processing capacity per 8.5 hours: 3.1 tons)
- Filter press: 1 unit (processing capacity per 45 minutes: 1,500kg)
- Extruder: 1 unit (processing capacity per 45 minutes: 500kg)
- Arc: 3 units
- Kiln: 2 units (One unit is $5m^3$ and is used for rental to small manufacturers, and other one is $1/4m^3$ and is used for product development and baking test at the center. Maximum temperature is 1,300 degrees (10% of total) and minimum temperature 1,150 degrees (90%), with the average temperature of 1,250 degrees.)

Compared to CSFU's production equipment's installed capacity of 75 tons/month, actual production accounts for only 40%. In fact, the installed capacity is designed to meet demand from small- and medium-sized manufacturers who would have moved from the Dinoyo district to the area around CSFU's site under a plan. However, few manufacturers have moved in to result in excess capacity.

Producing areas of raw materials for complex clay for body, consumption, and prices are as follows:

Material	Producing Area	Mixing Ratio (%)	Price (Rp./kg)
Feldspar	Blitar (Lodoyo)	28	75
Kaolin	Belitung	42	250
Clay	Rembang	8	55
Quartz	Tuban	22	55

Producing areas of raw materials for complex clay for glaze, consumption, and prices are as follows:

Material	Producing Area	Mixing Ratio (%)	Price (Rp./kg)
Feldspar	Blitar (Lodoyo)	60	75
Kaolin	Belitung	9	250
Quartz	Tuban	23	55
Talc	China	8	400

6.8 Technical Service Unit (TSU)

(Unit Pelayanan Teknis: UPT)

6.8.1 General

Unit Pelayanan Teknis (Technical Service Unit: TSU) is an organization of Purwakarta Prefecture. It was established in 1973 to support small- and medium-sized manufacturers of ceramic products. The center serves local industries in Purwakarta (16 villages, land area of 1,300ha, 27,000 population).

UPT has 10 employees. Only one of them is a qualified instructor. Two employees are currently receiving instructor training.

6.8.2 Activity description

At present, there are 127 small- and medium-sized manufacturers of ceramic products in Plered, of which 90% are small enterprises and 10% medium-sized enterprises. The center provides them with the following services.

(1) Supply of raw material

As one of its important services, UPT supplies ready-mix material for immediate use to local companies. At present, 10 tons are produced and supplied each month. In the Plered district, there are around 20 individuals and companies who supply ready-mix material under instruction of the center, with total monthly supply of 40-50 tons. On the other hand, some of large companies produce 4 tons of ceramic products per week, and ready-mix material is still in short supply. Also, some of small- and medium-sized ceramic manufacturers (mainly novelty goods) have their own ready-mix material

production facilities, but some need ready-mix material more than they produce. This means additional demand for local ready-mix material manufacturers as well as UPT.

Previously (10 years ago), UPT supplied glaze, which has been entirely replaced with paint.

(2) Technical assistance

UPT provides local ceramic manufacturers with technical assistance in the areas of raw material, sub-material, production technology, and facilities and equipment.

(3) Rental of kiln

UPT rents kilns to local manufacturers who produce more than their own kiln capacities.

(4) Management guidance

UPT provides management consultation and guidance for local enterprises.

6.8.3 Facility and equipment

Major equipment owned by UPT is as follows.

(1) Kilns

UPT owns 4 kilns, 2 of which burn firewood and coal, and 2 burn gas. One kiln is rented to a manufacturer in the district who does not have its own kiln, on a shared basis.

(2) Mills

There are two mils to produce white and red engobes. Engobe is used for some portions of products. Other products are painted or embossed with colorful patterns after baking (600 - 1,000 degrees).

6.8.4 Raw materials

Clay, one of major raw materials for UPT's production, is extracted in Citeko, 2km from the center. There are many clay miners in the district. There are large amounts of clay resources to meet consumption by around 600 tile manufacturers, including 15 large companies. Annual floods mire excavated areas and return them to the original state. Clay in Citeko has high quality in a lower layer (50-100cm), compared to poor quality in a upper layer (0 - 50cm).

Ready-mix material produced by the center is composed of 80% Citeko clay, 10% lime, and 10% quartz. Quartz and lime are crushed before use. Three ingredients are mixed to form a slip which then passes through 60 mesh and is allowed to sediment. After water is removed, the cake is placed on tile until it dries to 20% moisture content and packed in a 25kg bag for shipment.

Table 6-1 Number of Staffs of BBK in Speciality and Graduation

Education	Male	Female	Total
Doctorate Degree in Ceramic Engineering	1	–	1
Master Degree in Ceramic Engineering	1	–	1
Master Degree in Chemistry	1	1	2
Subtotal	3	1	4
Bachelor Degree in Technical Science	10	3	13
Chemistry	5	3	8
Art	3	1	4
Social Science	5	8	13
Statistics	1	–	1
Subtotal	24	15	39
Three–Year College Degree in Technical Science	8	1	9
Chemistry	1	1	2
Physics	1	–	1
Social Science	2	–	2
Foreign Language	–	1	1
Subtotal	12	3	15
Senior High School	87	21	108
Junior High School	16	3	19
Elementary School	18	–	18
Subtotal	121	24	145
TOTAL	160	43	203

Table 6-2 R/D Theme on Ceramic Raw Material during Last Three Years and its Budget

Year	Theme	Budget (Rp)	Term (Year)	No. of Person in Charge
1992	Research on processing and characterization Central Sulawesi's Chromite for ceramic raw industry	5,498,000	1	6
1992	Utilization of Wonokerto Pyrophillite Kaolinitic Clay for slag resistant refractories	7,189,000	1	6
1992	Research on technology for processing WUU-MAUMERF Clay for ceramic industries	7,883,000	1	6
1993	Characterization and utilization Southeast Sulawesi's Feldspar for ceramic industries	7,665,000	1	6
1993	Utilization Bukit Asam Clay for ceramic building materials by adding additive	6,977,000	1	6
1994-95	Beneficiation of Feldspar from North Sumatra and Northeast Aceh for ceramic raw materials	15,864,000	1	6

Table 6-3 Budget (B) of Research and Testing for Ceramic Raw Materials and Products in Total Budget (A)

(Unit: '000Rp)

Year	Budget(A)	Budget(B)	B/A (%)
1992	1,003,813	289,495	28.8
1993	1,159,324	262,603	22.6
1994	1,438,642	570,507	39.6

Table 6-4 Name of Facilities and Equipments (1/6)

No.	Item	Name	Q'ty	Production Date	Origin	Specification	Working Condition	Calibration		Maintenance	
								Method	Frequency	Method	Frequency
I.	Chemical Analysis	1. AAS	1	82	Holland	Pye Unican Sp. 9 /Philips	Good	Routine Check Compared with Standard	12/year	Cleaning	Before using
		2. Spectro Plus	1	77	England	NSE Spectro Plus	Good	Routine Check Compared with Standard	12/year	Cleaning	Before using
		3. Flame Photometer	2	84	England	Corning 400	Good	Routine Check Compared with Standard	12/year	Cleaning	Before using
		4. X-Ray Fluoresence Spectrometry	1	80	Holland	Philips P.V. 1410	Good	Routine Check Compared with Standard	12/year	Cleaning	Before using
		5. PH. Meter	2	81	Holland	Pye Unican	Good	Routine Check Compared with Buffer Standard	12/year	Cleaning	Before using
		6. Colorimeter	1	78	Japan	ERMA AE 11	Good	Routine Check Compared with Standard	12/year	Cleaning	Before using
		7. Analytical	8	74/84	West Germany	Sauter/Sartarins	Not working: 2	Intern Check with Standard Extern Check (Obligation)	12/year Annual	Cleaning, zero setting Cleaning	Before using
II.	Micro Structure Instrument	1. X-Ray Diffraction	1	78	Holland	Philips PV. 1130/00	Good	Goniometer Extern Check	2/year	Cleaning	Before using
		2. SEM	1	82	Holland	Philips 505	Good	Accuracy of Magnification Scale (extern)	2/year	Cleaning	Before using
		3. IR Spectrophotometer	1	83	Holland	Philips/Pye Unican SP. 3-300	Good	Routine Check Compared with Standard	12/year	Cleaning	Before using

Table 6-4 Name of Facilities and Equipments (2/6)

No.	Item	Name	Q'ty	Production Date	Origin	Specification	Working Condition	Calibration		Maintenance	
								Method	Frequency	Method	Frequency
III.	Thermal Testing	1. Calorimeter	2	74	Holland	Callencamp. Cat. No. CB. 110 App. No.: 14 CB. 110	Good	Thermometer Extern Check	1/year	Cleaning	Before using
		2. Thermal Conductivity Tester	1	80	Kyoto Electrical (Japan)	TC. 31 KARER	Good	Digital Temperature System Check (extern)	1/year	Cleaning	Before using
		3. Electrical Furnace	9	79	Germany	MABER LTB (1,200℃)	Working: 7	Trayek Temperature Firing Check	1/year	Cleaning	Before using
		4. Drying Furnace	7	79/75	West Germany	1. Hammer 2. Gallenkamp. Model in Holland Qal. 744 FD 1,500℃ 3. Salvis in Ventur No. 321035/004 4. Qal. 325 GH	Not Working: 2	Trayek Temperature Firing Check	1/year	Cleaning	Before using
		5. Dilatometer	2	75	Germany	METZTSCH Max. 1,400℃	Good	Dial Temperature Check	1/year	Cleaning	Before using
		6. Heating Microscope	1	78	Germany	I&ITZ. 301-200. 501	Good	Gradient Temperature Check	1/year	Cleaning	Before using
		7. Gradient Temperature Furnace (GTF)	1	83	USA	Harrop Model GTF 30-MD	Good	Gradient Temperature Check	1/year	Cleaning	Before using

Table 6-4 Name of Facilities and Equipments (3/6)

No.	Item	Name	Q'ty	Production Date	Origin	Specification	Working Condition	Calibration		Maintenance	
								Method	Frequency	Method	Frequency
III.	Thermal Testing	8. PCR Tester	1	78	USA	Bickley Model 1800 B	Good	Gradient Temperature Check & Flowmeter Check	1/year	Cleaning	Before using
		9. Thermal Shock Tester	1	87	Japan	Fuji 100℃	Good	Dial Temperature Check	1/year	Cleaning	Before using
		10. Softening Point Tester	1	73	USA	Harrop Lab. Modell Sp. IA	Good	Gradient Temperature Check	1/year	Cleaning	Before using
		11. Annealing and Strain Point Tester	1	73	USA	Model Sp. 2A	Good	Gradient Temperature Check	1/year	Cleaning	Before using
		12. DTA/TGA	1	73	Germany	WETTJ&R	Not Working	Gradient Temperature Check	1/year	Cleaning	Before using
IV.	Optical Testing	1. Polarisation Microscope	2	-	Austria	Reichert MR 245-791	Not Working	Routine Check	Before using	Cleaning	Before using
		2. Gloss Meter	1	91	Japan	Minolta GM 060	Good	Routine Check Compared with Standard	1/year	Cleaning	Before using
		3. Refractory Abbe	2	77/92	Germany	Carl Zeiss	Good	Routine Check Compared with Standard	1/year	Cleaning	Before using
		4. Optical Distorsin Testing	1	79	Japan	Cabin Automat Rotary Cerie No. 193700780	Good	Routine Check Compared with Standard	1/year	Cleaning	Before using
		5. Optical Devision Testing	1	79	-	Local	Good	Routine Check	1/year	Cleaning	Before using

Table 6-4 Name of Facilities and Equipments (4/6)

No.	Item	Name	Q'ty	Production Date	Origin	Specification	Working Condition	Calibration		Maintenance	
								Method	Frequency	Method	Frequency
IV.	Optical Testing	6. Transmision Tester	1	-	Holland	Vitatron	Good	Routine Check Compared with Standard	Before using	Cleaning	Before using
		7. Haze Meter	1	87	Japan	Suga test instrument Type BGM/3 RP No. CH 287104	Good	Digital Transmission Check	1/year	Cleaning	Before using
		8. Polari Meter	1	77	England	B. GIRA	Good	Routine Check Compared with Stain Disc Standard	Before using	Cleaning	Before using
		9. Shade Band Comparative Testing	1	87	Japan	Shade Band & Color	Good	Routine Check Compared with Color Standard	1/year	Cleaning	Before using
V.	Mechanical Testing	1. Universal Testing Machine	2	74/83	Germany	Hohr & Federbass A.G	Good	Nanoter Check	1/year	Cleaning	Before using
		2. Bending Stength Tester	1	76	Germany	Metzch max 60 kg	Not Working: 1	Nanoter Check	1/year	Cleaning	Before using
		3. Inpact Strength Tester	3	52	Japan/Germany	Tachikawa-Ton Industrie	Good	Weight Check	1/year	Cleaning	Before using
		4. Bag Impaction Tester	1	82	Local	Tachikawa-Ton Industrie	Good	Weight Check	1/year	Cleaning	Before using
		5. Increment Presure Tester	1	76	USA	Butler PA 1802	Not Working: 1	Pressure Check	1/year	Cleaning	Before using
VI.	Physical Testing	1. Viscometer	1	84	England	Say Bott	Good	Viscosity Check	1/year	Cleaning	Before using
		2. Autoclave	3	81-83	Germany -England	Ton Industri-Farnell	Good	Nanometer Check	1/year	Cleaning	Before using
		3. Density Comparator	1	72	USA	AGR	Good	Viscosity and Temperature Check	1/year	Cleaning	Before using

Table 6-4 Name of Facilities and Equipments (5/6)

No.	Item	Name	Q'ty	Production Date	Origin	Specification	Working Condition	Calibration		Maintenance	
								Method	Frequency	Method	Frequency
VI.	Physical Testing	4. Radiation UV Tester	1	87	Japan	Type MLG-1, No inf 487104 Suga Test Instruments Co. LTD	Good	Intensity UV Ray & Temp Check	1/year	Cleaning	Before using
		5. Abrasion Tester	7	87-87	Italy-USA	PEI Method-Teledyne Taber	Not Working: 2	Rotation, Hardness & Weight Check	1/year	Cleaning	Before using
		6. Ultra-X	1	80	Germany	Mur Siebering MR 5607	Good	Moisture Scale Check	1/year	Cleaning	Before using
		7. Sedimentation Balance	1	79	Germany	Sartonius Type 4610 MR 280. 7009	Good	Weight Tester	1/year	Cleaning	Before using
		8. Binocular Microscope	2	-	Germany	Zeiss 4750-22	Good	Routine Check	Before using	Cleaning	Before using
		9. Mob's Scale	2	-	Germany	Ton Industrie-Berlin Fste Deman	Not Working: 2	-	-	Cleaning	Before using
		10. Sieve Shaker	5	78	Germany	Cenco-Neinter Catalog 18480	Good	Speed Check	1/year	Cleaning	Before using
		11. Vicat	2	-	India	-	Not Working: 1	-	Before using	Cleaning	Before using
		12. Plasticity Meter	5	79	England	ELE	Not Working: 2	-	-	Cleaning	Before using
		13. Whitness Tester	1	85	Japan	Kaett Electric Lab Model C. 100	Good	Routine Check Compared with Standard	1/year	Cleaning	Before using
		14. Blaine	2	82	Germany	Toni Technic	Not Working: 2	Material Standard Check	Before using	Cleaning	Before using
		15. Climax Box	2	-	USA	Fison Type 280	Not Working: 1	Material Standard Check	Before using	Cleaning	Before using
		16. Flow Table	1	82	USA	Bumbolot-MTD 06	Good	-	-	Cleaning	Before using

Table 6-4 Name of Facilities and Equipments (6/6)

No.	Item	Name	Q'ty	Production Date	Origin	Specification	Working Condition	Calibration		Maintenance	
								Method	Frequency	Method	Frequency
VI.	Physical Testing	17. Gas Detector	2	75-85	Japan-Holland	Kitagawa Model 400/Galencamp Serie 414	Not Working: 1	Routine Check Compared with Standard	1/year	Cleaning	Before using
		18. Length Comparator	2	82-84	Japan	Tani Fuji	Good	Scale Check	1/year	Cleaning	Before using
		19. Water Betention Tester	1	84	USA	Bumboldt-MF 6	Good	-	1/year	Cleaning	Before using
		20. Absorption Capacity Tester	1	57	Germany	Ton Industrie Max 400kg/cm	Good	Dial Pressure Tester	1/year	Cleaning	Before using
		21. Tile Tester	2	75	Local	Local 20 cm x 20	Good	Dial Gauge Test	1/year	Cleaning	Before using
		22. Dimension Glass Tester	5	77	Holland	Completed with Dyle Micro Meter	Good	Dial Gauge Test	1/year	Cleaning	Before using
		23. Dielectric Strength Tester	1	-	Japan	Rikosha 0-58 kv	Good	Voltage Check	1/year	Cleaning	Before using

Table 6-5 Number of Staffs of MTRDC in Speciality and Graduation

Education	No. of Staff
Doctoral Degree	6
Post Graduate (S2)	28
Mining Engineer	42
Geologist (S1)	19
Graduate of Chemistry	4
Technical Chemistry Engineer	6
Graduate of Statistics	8
Physical Engineer	2
Electrical Engineer	1
Industrial Engineer	1
Biologist	2
Geographer	2
Graduate of Social Science, Economics, etc.	22
Subtotal	143
Three-Year College Degree in	
Mining	28
Geology	3
Chemistry	5
Machinery	2
Industry	1
Social Science, Economics, etc.	15
Computer	1
Subtotal	55
Senior High School	210
Junior High School	26
Elementary School	26
Subtotal	262
TOTAL	460

Table 6-6 Number of Staffs of DSM in Speciality and Graduation

Education	No. of Staff
Geologist	121
Mining Engineer	51
Geophysicist	10
Geodesicist	4
Chemist	41
Mathematician/Statistician	6
Subtotal	233
Three-Year College Degree in	
Researcher/Engineer	233
Drilling/Other Technician	140
Surveyor	51
Administration	179
Security Guard/Driver/Messenger	75
TOTAL	678

Table 6-8 Drilling Machine

No.	Drilling Machine	Capacity (m)		Quantity (Unit)
1	Long Year 38 Truck Mounted	600	(NQ)	2
2	Long Year 38 Skid Mounted	575	(NQ)	2
3	Long Year 34 Skid Mounted	336	(NQ)	3
4	Long Year 24 Skid Mounted	220	(AQ)	1
5	Long Year HC-28 Skid Mounted	305	(BQ)	2
6	Koken RK-3A Skid Mounted	500	(NQ)	1
7	Koken OE-8 BH Skid Mounted	300	(BQ)	1
8	Tone Top-150 Crawler Mounted	300	(NQ)	1
9	Tone THS-5m Skid Mounted	400	(BQ)	1
10	EDECO SD-40 Skid Mounted	488	(NQ)	2

Table 6-7 Reserves of Mineral Resources as of 1992

	Mineral Commodities	Reserves (ton)
A. Strategics Minerals Commodities		
1	Nickel*	870,358,414
2	Cobalt	998,480
3	Tin	1,385,538
B. Vital Minerals Commodities		
1	Coal	20,577,222,252
2	Peat+	18,166,060,000
3	Iron	2,091,157,276
4	Manganese	4,915,386
5	Molybdenum	239,500
6	Chromite*	5,735,492
7	Titanium	7,246,440
8	Bauxite	894,489,802
9	Copper	8,383,066
10	Lead	3,685,424
11	Zinc	2,022,697
12	Gold	1,547
13	Platinum**	11,051
14	Silver	6,554
15	Mercury	5,306,297
16	Diamond***	5,767,783
17	Barite	3,255,921
18	Iodine	756,299
19	Sulfur	5,487,948
20	Monazite	4,534
21	Antimonite	43
C. Industrial Minerals/Rocks Nirstrategi/Nirvital		
1	Phosphate	4,007,453
2	Zeolite	206,814,633
3	Jarocite	797,350
4	Quartz Sand	4,651,514,553
5	Kaolin	931,357,596
6	Toseki	381,514,219
7	Bentonite	1,369,407,100
8	Clay	2,712,789,775
9	Feldspar	2,547,499,633
10	Ball/Bon Clay	45,111,095
11	Gypsum	0
12	Diatomite	131,665,817
13	Marble	8,613,396,557
14	Andesite Basalt	2,651,311,329
15	Granite	10,299,018,986
16	Pheridotite	6,000,000
17	Trachyte	900,000,000
18	Gneiss	17,374,721
19	Limestone	28,809,588,716
20	Dolomite	1,459,562,223
21	Calcium Carbonate	146,161,000
22	Onyx	37,455
23	Magnesite	34,249,070
24	Perlite	309,279,000
25	Obsidian	54,045,000
26	Pumice	105,077,432
27	Trass	1,466,625,687
28	Asbes	10,076,437
29	Pyrophyllite	550,749,819
30	Sand/Gravel	19,120,547
31	Salestone	35,281,000
32	Calsite	10,080,446
33	Sand	0
34	Sea Sand	124,423,906
35	Mica	726,067,511

Note: * Not including associated with iron laterite
** in Kilogram *** in Carat + in Meter cubics

Table 6-9 Map Types, Contents and Uses

Map Type and Scale	Map Contents	Map Use
Geological Maps 1:50,000 1:100,000 & 1:250,000	- Distribution of rock - Types relationship and superposition between rocks units - Mineral and energy prospects	- Geological information for various exploration mineral and energy resources, groundwater, geotechnics etc. - Geological information for other development sectors: DEPPU, DEPTAN, DEPHANKAM, DEPTRAN, DEPDAGRI, DEPPERIN, DEPHUB, etc. - Basic data for earth sciences
Geological Maps 1:500,000 & 1:1,000,000	- Distribution of rock groups - Regional stratigraphic sequence and age of rock groups - Mineral and energy prospects	- Regional geological information for various mineral and energy prospecting and exploration - Regional geological information for various development planning sectors - Regional geological information for earth scientists
Geological Maps 1:2,000,000 & 1:5,000,000	- Distribution of rock groups - Distribution of sedimentary basins, trends of magmatic activity, metamorphosis and structure - Regional geological structure - Broad pattern of mineral and energy resources	- Regional geological information for types of regional prospecting, exploration and planning - Regional geological information for earth scientists
Gravity Anomaly Maps 1:100,000 & 1:250,000	- Gravity anomaly structure 2~5 mgal interval	- Basic information concerning the earth's crust for exploration based on density differences and for studying structural geology
Magnetic Anomaly Maps 1:100,000 & 1:250,000	- Magnetic anomaly contours/Rock magnetic susceptibility contours 1~10 gamma intervals	- Basic information for exploration based on differences in magnetic susceptibility of rocks and for the study of structural geology
Quaternary Geological Maps 1:50,000	- Distribution of rock units - Distribution of environmental units - Subsurface deposits	- Coastal development - Development of the science of Quaternary Geology Units--Monitoring the environment
Geomorphological Maps 1:100,000	- Morphogenetic units - Units of surface deposits - Terrain analysis	- Regional physical development - Environmental monitoring
Seismological Maps 1:250,000	- Distribution of macro and micro centers - Distribution of geological structures (active and non-active) - Isoseismal contours - Distribution of rock types	- Earthquake analysis - Relationship between geological structures and earthquakes - Data supporting regional development and overcoming earthquake disasters - Development of geological science, especially neotectonics
Seismological Maps 1:5,000,000	- Distribution of deep, medium and shallow earthquake centers - Distribution of geological structures - Distribution of rock units	- Macro and micro analysis of earthquakes - Regional patterns of geological structure - Identification of areas susceptible to earthquakes - Development of geological science, especially neotectonics

Table 6-10 List of Laboratonum and Survey Equipment of Geological Research and Development Center

Name of Equip/Instrument	Quantity (Unit)	Explanation
Scanning Electron Microscope (SEM)	2	Electron microscope with a magnification capacity of x 180,000
Electron Microprobe Analyses (EPMA)	1	Instrument for chemical analysis
X-ray Diffraction (XRD)	1	Instrument for analyzing minerals based on crystal structure
Different Thermal Analyses (DTA)	1	Instrument for analyzing minerals based on temp. reaction
Atomic Absorption Analyses (AAS)	2	Instrument for chemical analysis
Radio Carbon Dating (C-14)	1	Instrument for rock age determination based on C-14 content
Fission Track Dating	1	Instrument for rock age determination based on fission tracks
Potassium Argon Dating (K-Ar)	1	Instrument for rock age determination based on radioactive decay
- Mass spectrometer	1	Instrument in which substance are analyzed according to the mass of elements present in the sample
- Flame photometer	1	Instrument for rock analysis based on K & Na contents when heated
- Argon extraction	1	Instrument for extraction of argon from minerals
- Computer VAX 6220	1	With many terminals
Reprographic Camera	1	Camera for producing film positives, coloured maps and offset contact plates
Offset Printing Machine	1	Machine for printing books and other publications
Cartographic Equipment	1	Equipment for producing maps
Seismograph	15	Instrument for recording micro earthquakes
Binocular Microscope	5	Microscope for micro paleontology
Polarization Microscope	15	Petrographic microscope also used for photomicrographs
Reflection Microscope	2	Microscope for polished section ore determination
Fluid Inclusion Analyzer	1	Instrument for measuring original rock temp. by means of fluid inclusions
Thin Section & Polishing	1	Machine for preparing rock thin sections for microscopic analysis
Ultrasonic Cleaner	5	Instrument for disaggregating and cleaning rock specimens
Centrifuge	2	Instrument for mineral separation based on differences in mass
Oven	4	Heating instrument up to + 500℃
Furnace	4	Melting instrument up to temps + 2,000℃
Ion Analyzer	1	Instrument for ion analysis
Frantz Isodynamic Separator	3	Mineral separating instrument based on differences in magmatic susceptibility
Gravimeter	7	Instrument for measuring gravity
Thermal Demagnetizer	1	Instrument for demagnetizing rock samples in the lab.
Velocitymeter	1	Instrument for measuring seismic velocity of rock samples in the lab.
Porositymeter	1	Instrument for measuring rock porosity
Geoelectric	3	Instrument for measuring electrical conductivity of rock layers
Spiner Magnetometer	1	Instrument for measuring rock magnetism in the lab.
Paleomagnetic	1	Instrument for determining the paleomagnetic field
Deep well machine	1	Machine for obtaining sub surface rock samples
Shallow well machine	1	Machine for obtaining shallow surface rock samples
Sondir	1	Instrument for measuring bearing capacity of soil
Refraction Seismic	2	Instrument for recording seismic energy
GPS	3	Instrument for determining position
Magnetometer	8	Instrument for measuring of the earth magnetic field
Altimeter	10	Instrument for altitude measurement
DIPIX ARIES III	1	Instrument for digital interpretation and preparation of airphotos

Table 6-11 Number of Staffs of BPPIS in Speciality and Graduation

Education	No. of Staff
Bachelor Degree in	
Chemical Engineering	13
Biology	4
Pharmacology	2
Agriculture Technology	3
Chemical Education	1
Economy	1
Law	5
Social & Politic	1
Mechanical Education	1
Subtotal	31
Academy Degree in	
Chemical Engineering	13
Mechanical Engineering	1
Civil Engineering	1
Chemical Education	2
THP	1
AKA	1
ATK	1
Economy & Social	5
Subtotal	25
Vocational Senior High School	29
General Senior High School	25
Others	18
Subtotal	72
TOTAL	128

Table 6-12 Number of Staffs of BPPISu in Speciality and Graduation

Function	No. of Staff	Education	No. of Staff
Researcher	39	Bachelor Degree	27
Engineer	28	Academy Degree	6
Administrator	43	Senior High School and below	80
Assistant	3		
TOTAL	113	TOTAL	113

Figure 6-1 Organizational Structure of BBK

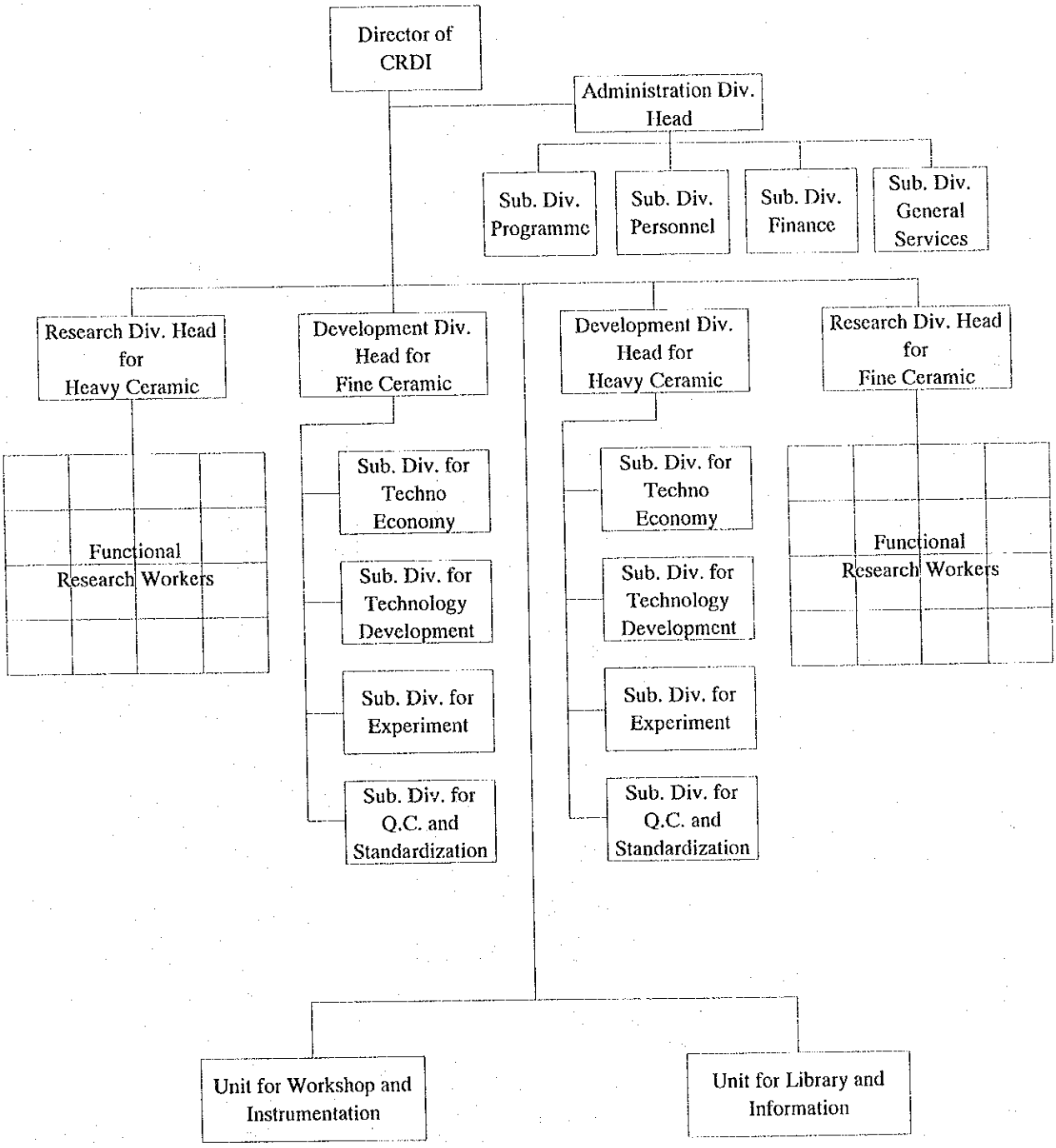


Figure 6-2 Organization Structure of Mineral Technology Research and Development Center

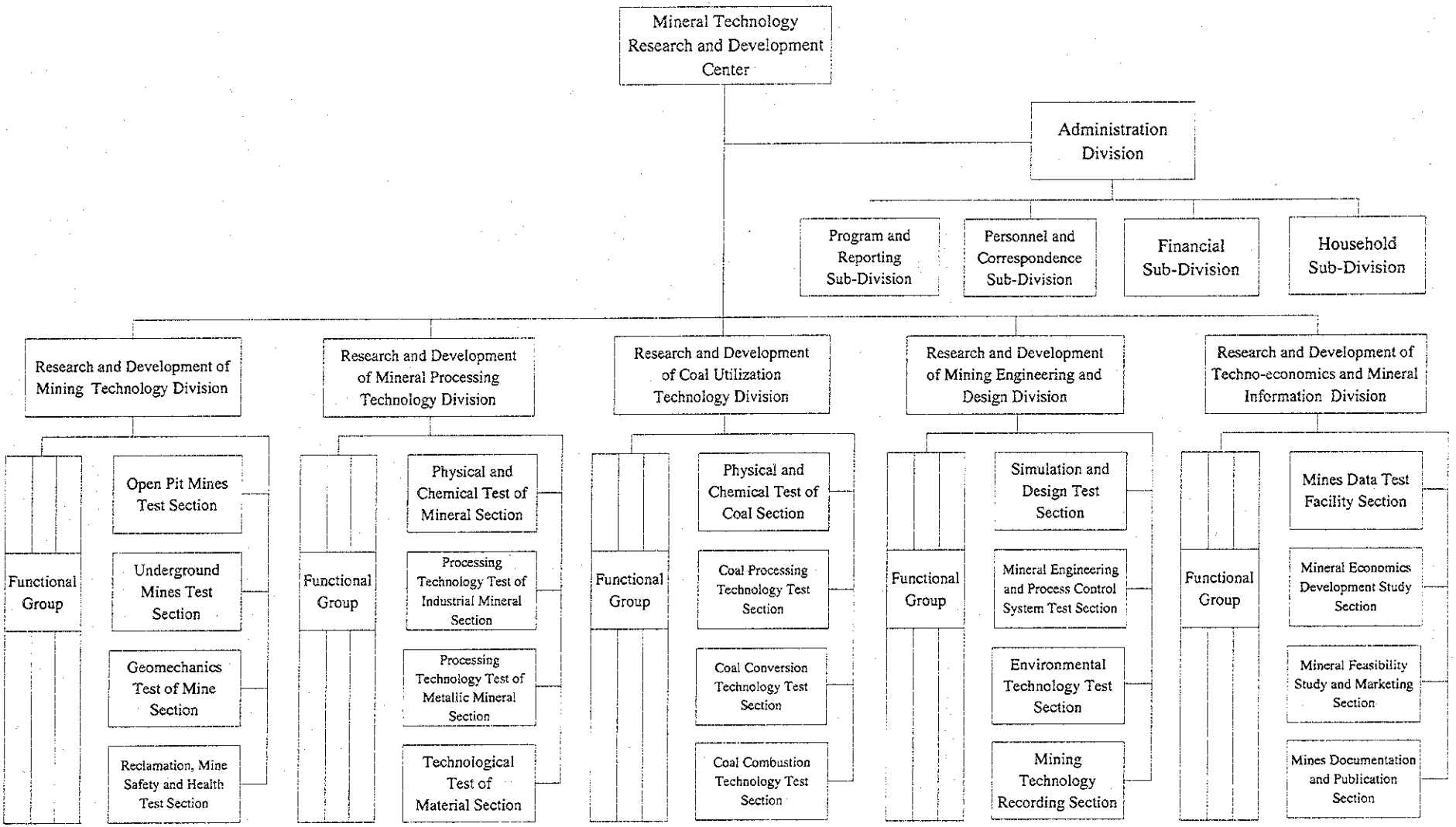
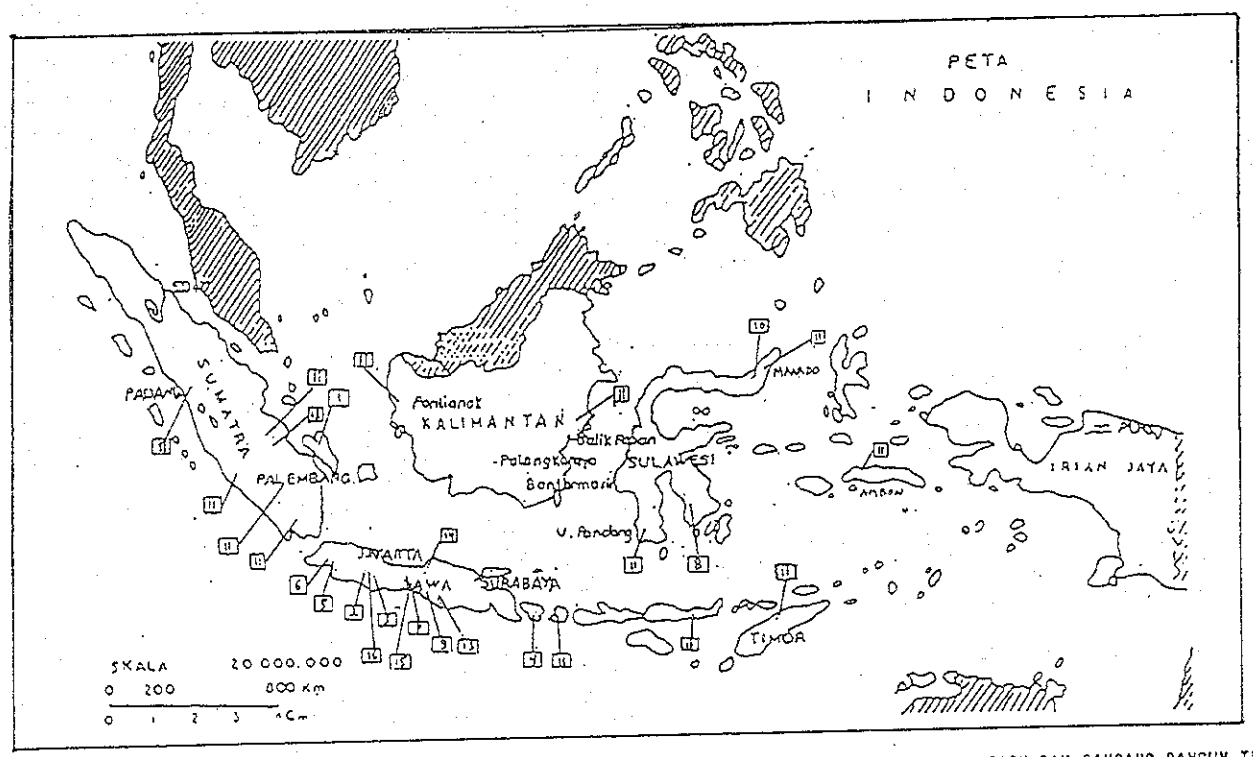


Figure 6-3 (1) Lokasi Kegiatan Proyek Pengembangan Teknologi Pengolahan Bahan Galian Tahun Anggaran 1995/1996



PENINGKATAN KUALITAS BAHAN GALIAN UNTUK INDUSTRI (TU-02)

1. Pemanfaatan Timah untuk Organotin, Sumatera Selatan.
2. Pembuatan Kapur Ringan untuk Bahan Pelapis Kertas, Jawa Barat.
3. Pembuatan Semen Pozolan, Jawa Barat.
4. Bimbingan Pembuatan Pewter untuk Perhiasan, Bali.
5. Pemanfaatan Zeolit untuk Bahan Katalis dan Pengolahan Limbah Skala Pilot, Jabar
6. Pemanfaatan Batu Aji/Mulia untuk Perhiasan, Jawa Barat.

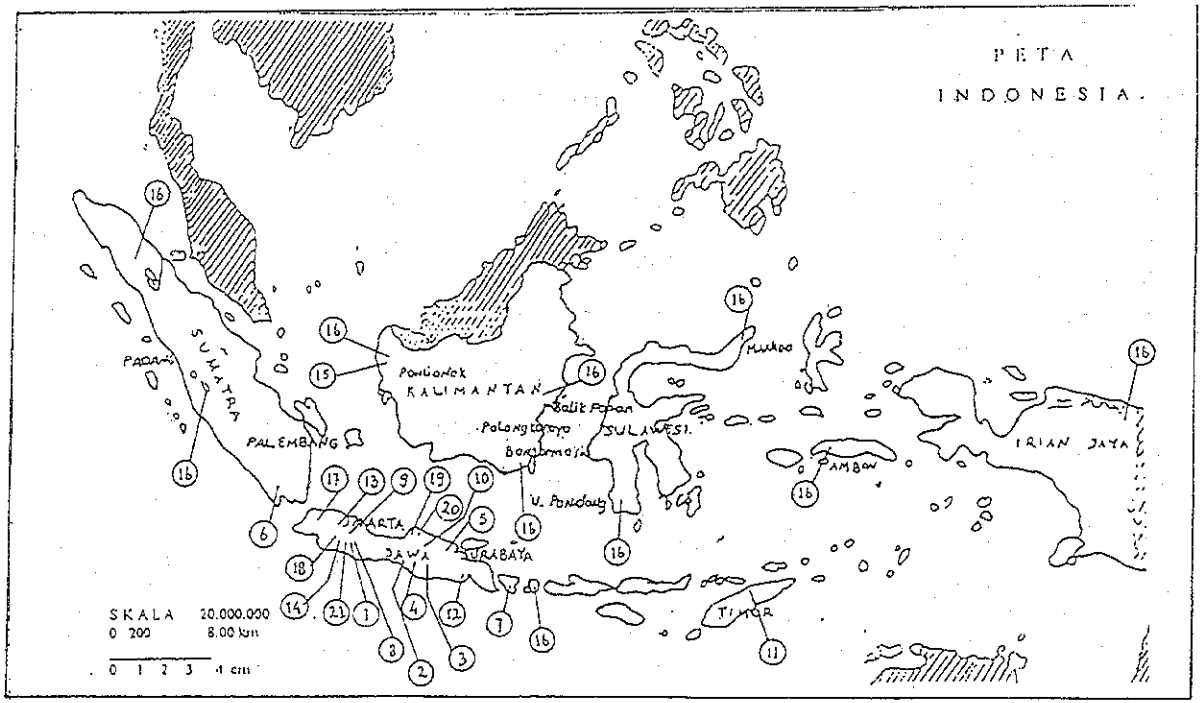
PENINGKATAN KINERJA TEKNOLOGI PENGOLAHAN BAHAN GALIAN (TU-03)

7. Peningkatan Kualitas Felspar Skala Kontinu, Jawa Tengah.
8. Ekstraksi Nikel-Cobalt dari Laterit, Sulawesi Tenggara.
9. Ekstraksi Titan dari Pasir Besi, D.I. Yogyakarta.
10. Pengelolaan Lingkungan Air Raksa pada Tambang Rakyat, Sulawesi Utara
11. Bimbingan Teknis Laboratorium Kanwil-Kanwil.

DISAIN DAN RANCANG BANGUN TEKNOLOGI PENOLAHAN BAHAN GALIAN (TU-04)

12. Disain dan Rancang Bangun Teknologi Pengolahan Emas, Jambi.
13. Disain dan Rancang Bangun Teknologi Pengolahan Bentonit, Jawa Tengah.
14. Disain dan Rancang Bangun Teknologi Pengolahan Pasir Kwarsa, Jawa Tengah.
15. Disain dan Rancang Bangun Teknologi Pengolahan Felspar, Jawa Tengah.

Figure 6-3 (2) Lokasi Kegiatan Proyek Pengembangan Teknologi Pengolahan Bahan Galian 1996/1997



TU. 02. PENINGKATAN KUALITAS BAHAN GALIAN UNTUK INDUSTRI

1. Pemanfaatan Tras untuk Industri Semen Pozolan, Skala Pilot, Jawa Barat.
2. Pemanfaatan Batumulia dan Granit untuk Industri Perhiasan, D.I. Yogyakarta.
3. Pemanfaatan Bentonit Skala Pilot untuk Bahan Pemucat (Industri Minyak Sawit), Jawa Tengah.
4. Pemanfaatan Felspar Skala Pilot untuk Industri Keramik, Jawa Tengah.
5. Pemanfaatan Dolomit Skala Pilot untuk Industri Tahan Api, Jawa Timur.
6. Pengolahan Emas dengan Konsentrasi Gravimetri Skala Pilot, Lampung.
7. Pemanfaatan Timah untuk Industri Perter, Bali.
8. Pemanfaatan Kaolin Skala Pilot untuk Bahan Tawas, Jabar.

TU. 03. PENINGKATAN KINERJA TEKNOLOGI PENGOLAHAN BAHAN GALIAN

9. Studi AMBAL Pabrik Pengolahan Semen Pozolan, Jawa Barat.
10. Ekstraksi Titan dari Pasir Besi, D.I. Yogyakarta.
11. Pemanfaatan Lempung untuk Bahan Baku Keramik, Timor-Timur.
12. Pemanfaatan Zeolit Skala Meja untuk Industri, Jawa Timur.
13. Pengolahan Lingkungan Pertambangan Kapur Rakyat, Jawa Barat.
14. Pemanfaatan Kapur untuk Industri Makanan, Jawa Barat.
15. Ekstraksi Logam Jarang Galium dari Bauksit, Kalimantan Barat.
16. Bimbingan Laboratorium Kanwil-Kanwil DPE.
17. Pembuatan Ni Sulfamat untuk Bahan Baku Elektroplating, Jawa Barat.

TU. 04. REKAYASA DAN RANCANG BANGUN TEKNOLOGI PENGOLAHAN BAHAN GALIAN

18. Rekayasa dan Rancang Bangun Proses dan Peralatan Pengolahan Bentonit, Bojongmanik, Jawa Barat.
19. Rekayasa dan Rancang Bangun Proses dan Peralatan Pengolahan Kaolin, Jepara, Jawa Tengah.
20. Rekayasa dan Rancang Bangun Proses dan Peralatan Pengolahan Semen Pozolan-Kapur, Pati, Jawa Tengah.
21. Rancang Bangun Simulasi Proses Cyanidasi Emas dan Perak, Garut, Jawa Barat.

Figure 6-4 Organization Structure of DSM

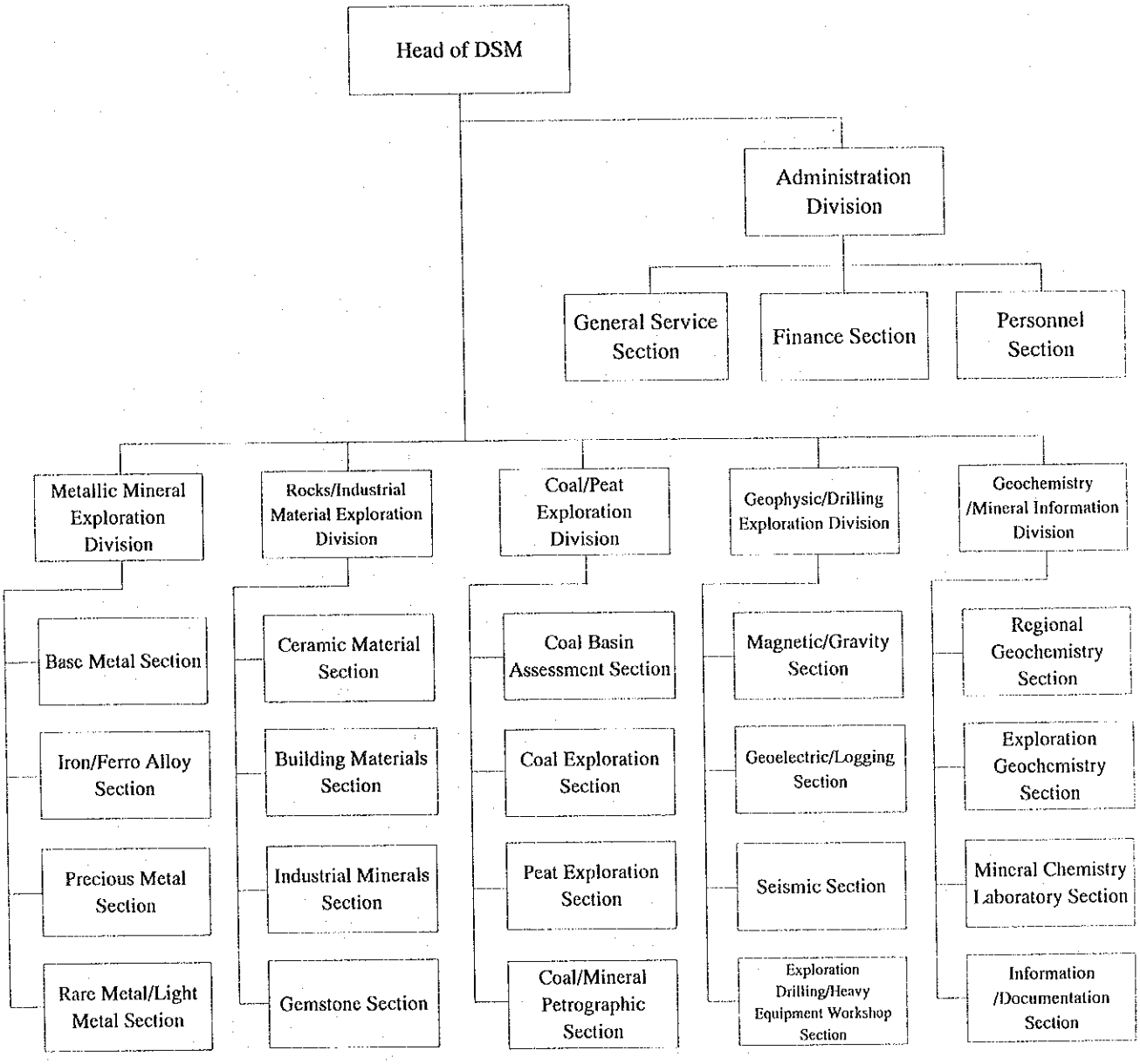


Figure 6-5 Organization Structure of the Geological Research and Development Center (3PG)

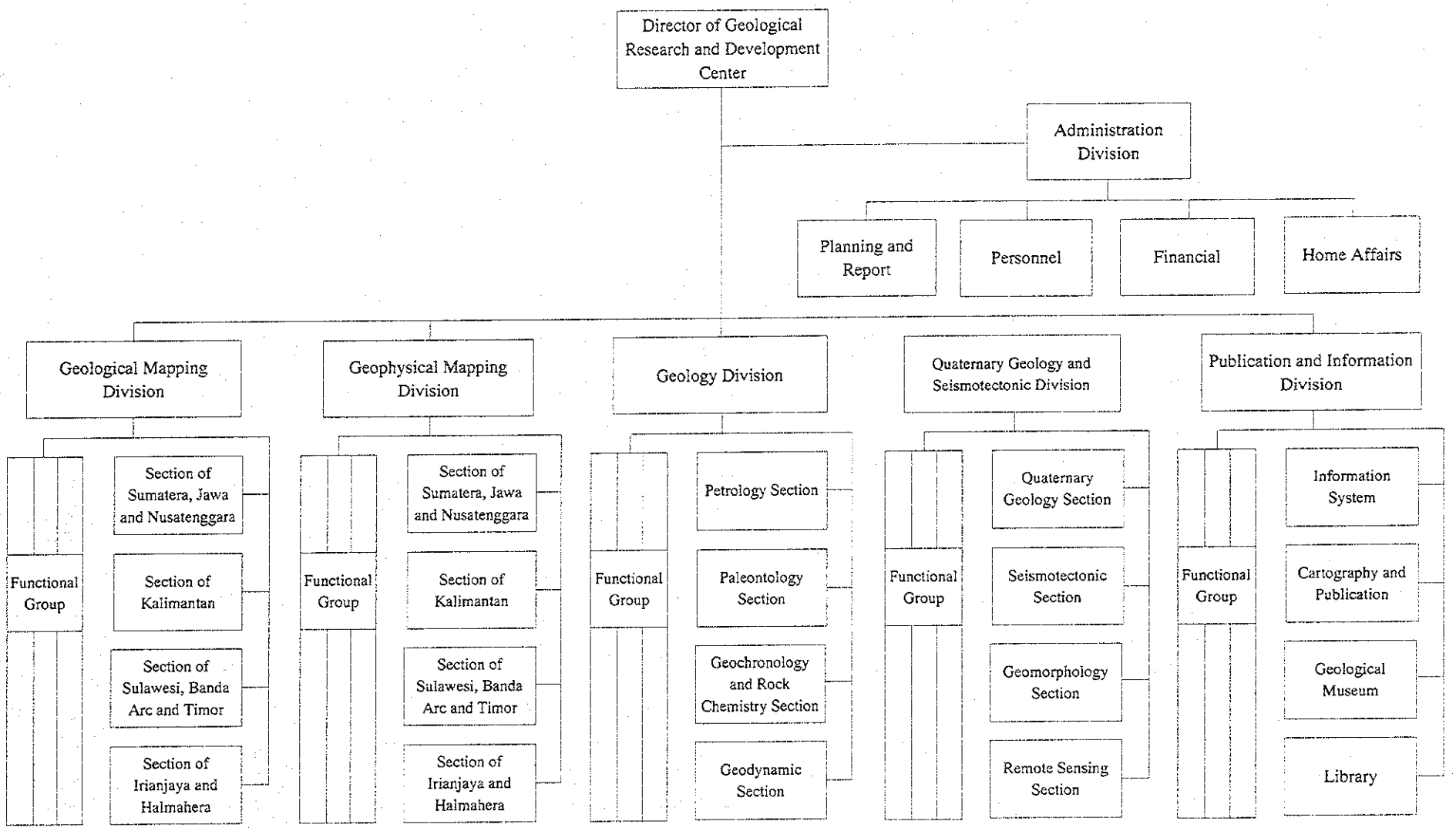


Figure 6-6 (1) Human Resources of Geological Research and Development Center Based on Education

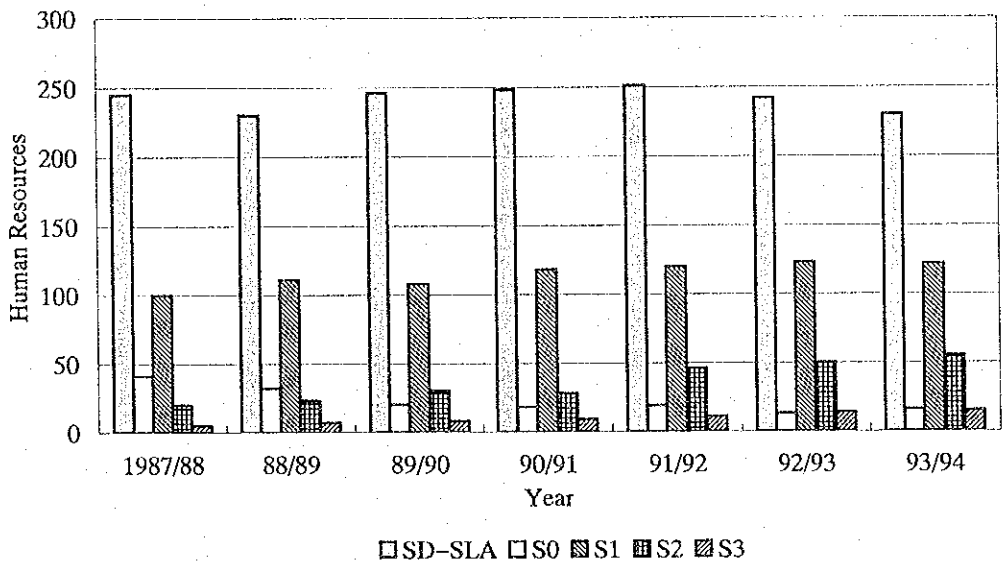


Figure 6-6 (2) Human Resources of Geological Research and Development Center based on Profession

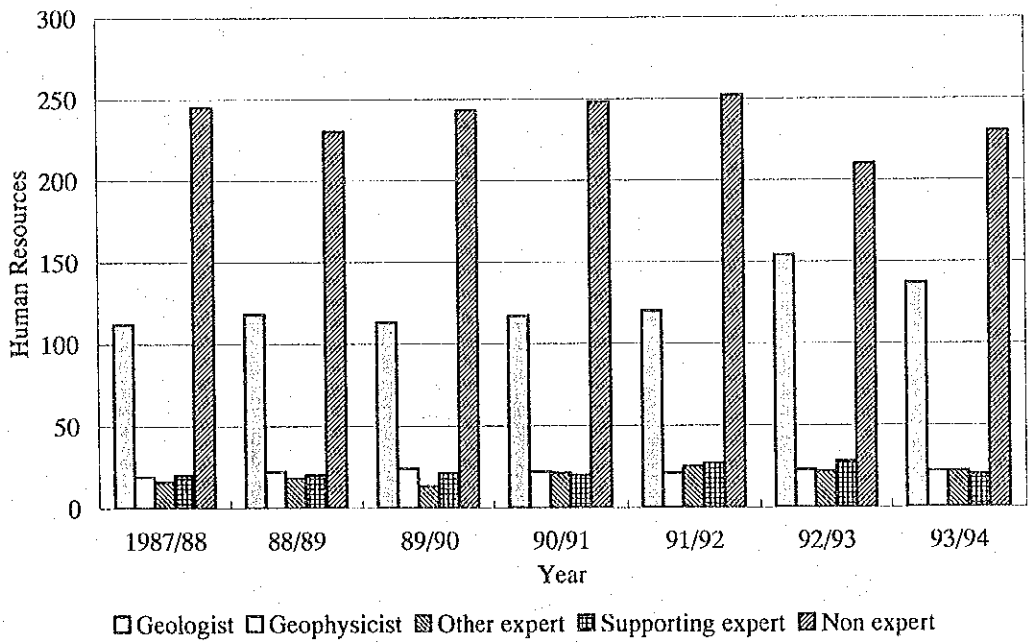


Figure 6-7 Organization Structure of BPPIS

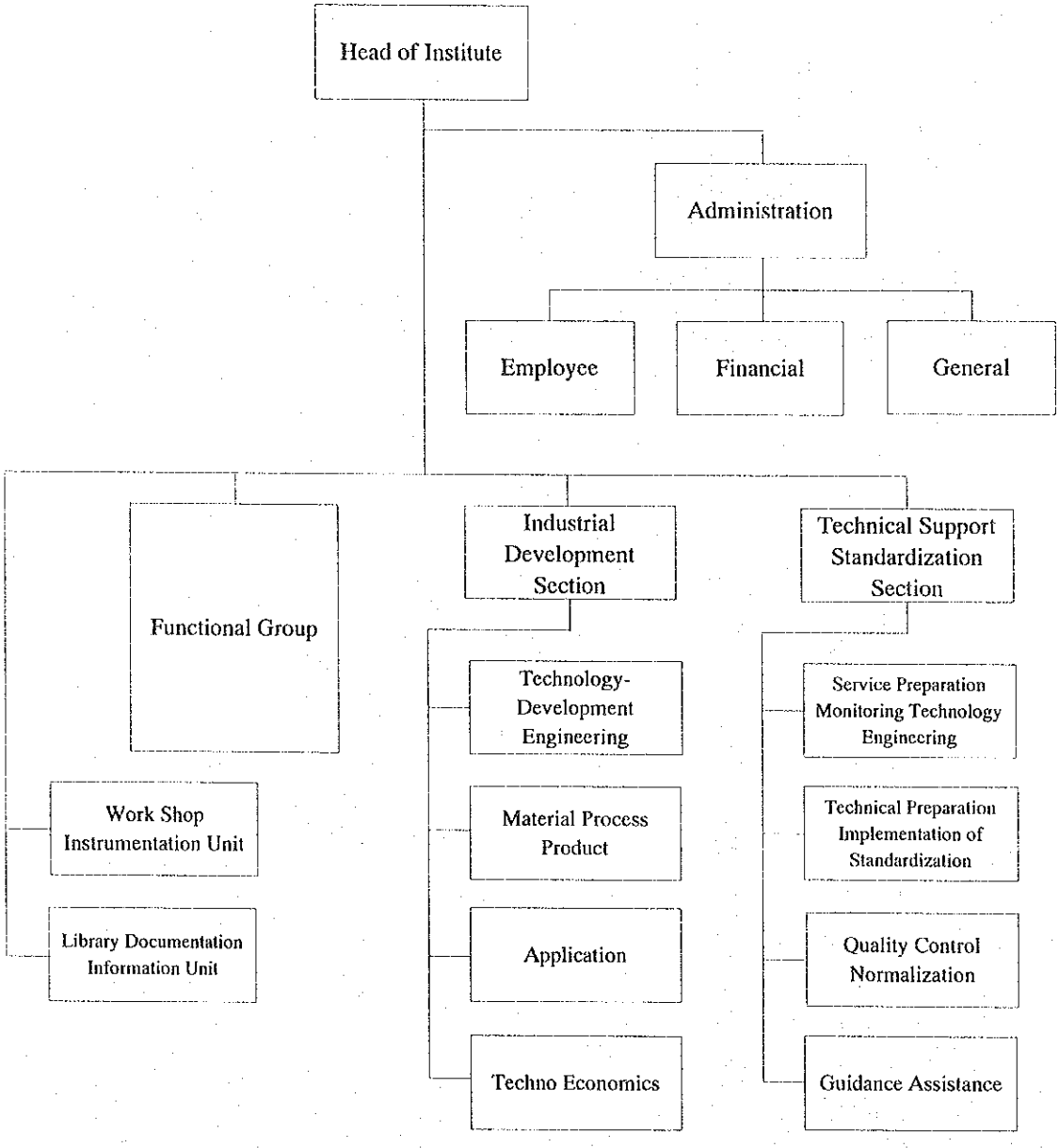
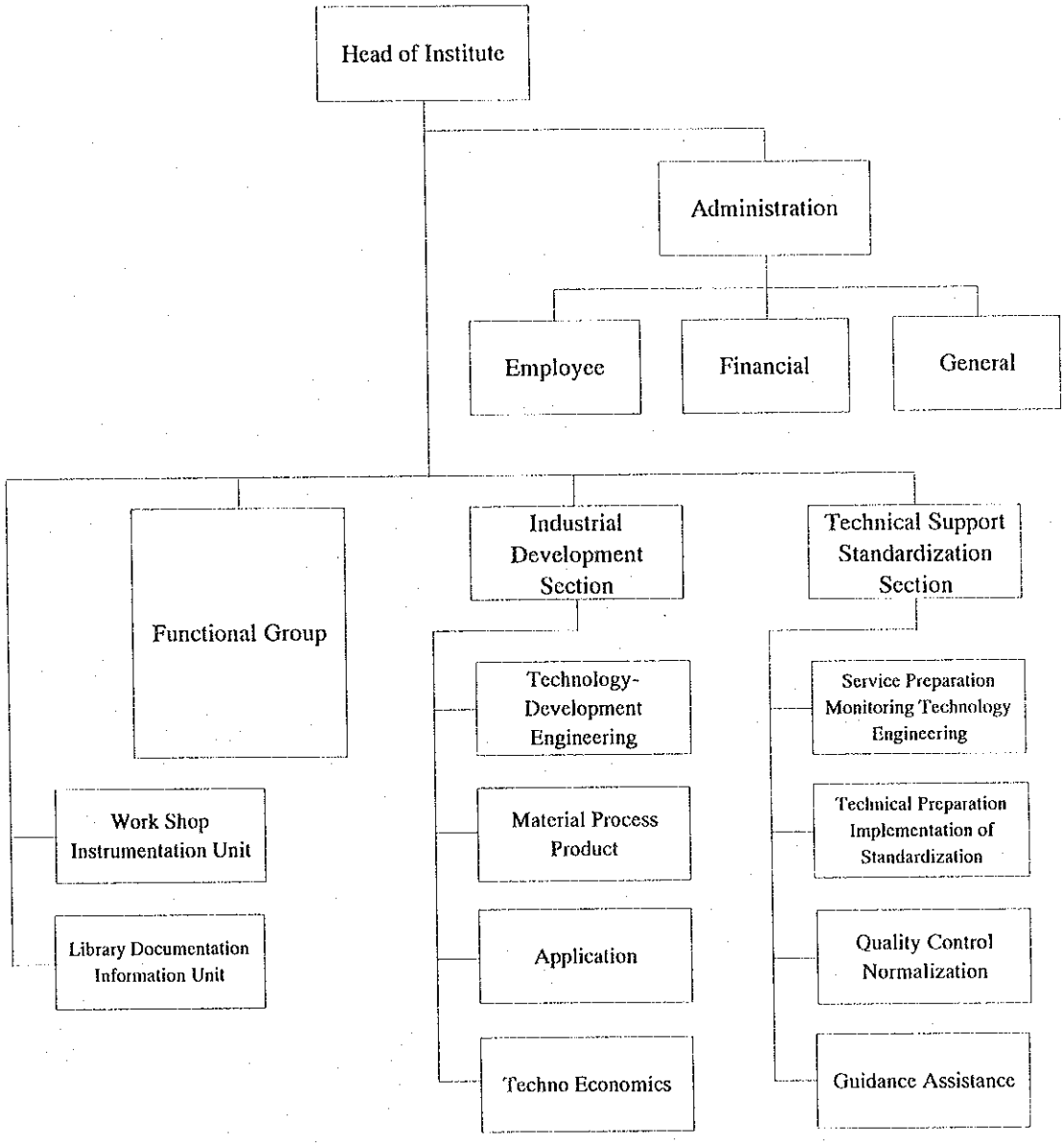


Figure 6-8 Organization Structure of BPPISu



7 Survey Results on Supply of Sub-materials

7.1 Conclusion on Promotion of the Sub-material Supply Industry

Current consumption patterns of sub-materials are shown in Tables 7-1 through 7-4 (details discussed later).

There are major bottlenecks to the promotion of the sub-material supply industry in Indonesia:

1) Raw materials of adequate grades are not available locally, and imported materials must be used.
2) Most of ceramic manufacturers, major sub-material users, directly import sub-materials or manufacture them by using imported raw materials, so that there is no motive for outsourcing.

At present, these problems are very difficult to overcome. Furthermore, the sub-material supply industry using imported raw materials is already emerging. Thus, it is not recommendable to take special measures to promote the sub-material supply industry as part of the plan.

Sub-materials used in the ceramic industry are classified according to the place of production and the source of raw materials, as follows:

1) Sub-materials imported;
2) Sub-materials locally manufactured by using imported raw materials; and
3) Sub-materials locally manufactured by using local materials.

They are further divided into those manufactured by specialized manufacturers and those produced by ceramic manufacturers for captive consumption.

7.2 Current State of Sub-Material Distribution, Feasibility of Local Production, and Restriction

(1) Glaze materials

1) Natural ingredients

Among natural ingredients for glaze, silica and limestone are generally locally sources. However, other materials, including feldspar, kaolin, and ball clay, are not locally procured because of inadequate grade of domestic materials, except for the limited use for production of low-grade glaze.

As for feldspar, Banjarnegara and Lampung products can become usable through beneficiation, the beneficiation cost is too high to make commercial production. Similarly, kaolin produced in Belitung and Bangka can only be used for sub-material production through strict quality control. Since existing suppliers are not much concerned about quality control, significant efforts will be required to establish the ability to produce kaolin of adequate quality. Finally, the Monterado clay can be beneficiated to a usable quality level, but cost effectiveness is unknown at this stage.

2) Artificial materials

Artificially produced materials for glaze include frit, zircon, zinc oxide, and pigment. Their prices are very high compared to those of natural ingredients. As a result, the glaze cost required for tile production is three times that for body production.

a) Frit

Frit demand in the country is estimated to reach nearly 150,000 tons annually. It is produced by foreign manufacturers as well as local companies. Main users are tile manufacturers who generally use locally produced frit with imported products. At present, the share of imported frit has reportedly declined to 50% - 60% of total frit consumption in the country.

b) Zircon

Zircon extender is made by pulverizing zircon sand. Annual demand is estimated to reach over 50,000 tons. Judging from statistics, local products account for over 10% (Table 7-4). Nevertheless, manufacturers visited by the study team use mostly imported products. Thus, local products seem to be used according to product quality requirements. Zircon sand is produced in Australia and South Africa. Local products may increase according to demand and other factors.

c) Pigments

Pigments supply also entirely relies on imports. Pigment is considered to be one of the most difficult industrial products to be localized. Nevertheless, a joint venture company manufacturing pigments already established in Surabaya, and such product blended using imported material is considered to increase.

d) Zinc oxide

Statistically localization ratio of zinc oxide is very high. Although research among ceramic manufacturers, not many factories are using locally produced zinc

oxide. On the other hand, localization is in progress as modern technology and is introduced from foreign partners. While consumption of local products will increase in future, there will likely be intensive competition with low-cost Chinese products which enter the market.

e) Ready-mixed glaze

Among medium- and large-sized manufacturers, only a few companies use imported ready-mixed glaze. On the other hand, a sizable number of small-scale ceramic manufacturers seem to purchase ready-mixed glaze, and there is strong demand for commercial supply.

(2) Transfer paper

There are several transfer papers manufacturers, both joint ventures with foreign companies and local companies, which products are increasingly used. Still, products imported from Europe and Korea are widely used, and in particular, multi-color transfer papers are dominated by imports.

Taking advantage of low cost labor, some of tile manufacturers do not use transfer papers and rely on direct silk printing that requires more labor. Some manufacturers use internally produced silk screens, and some uses directed printed silk screens are sometimes designed internally and manufactured in China. Also, some produce transfer sheets on their own. In the near future, locally produced transfer sheets will become the norm.

(3) Calcined gypsum

Gypsum forms are made by most of manufacturers, except for some small enterprises. On the other hand, most companies use imported calcium sulfate for forming. Most factories use imported gypsum because local products have poor quality. As shown below, Indonesian raw material is not appropriate for gypsum mold, because local made calcined gypsum contains high impurities and low in quality as a calcined gypsum. Comparison of analysis data between local and import calcined gypsum is as follows:

	Local	Import
SiO_2	5.10	0.24
CaO	38.00	44.00
Al_2O_3	1.60	0.09
SO_3	53.00	56.00
FeO_3	0.87	0.06

Note: Analyzed by the Team after drying at 500℃

However, domestically produced gypsum has been partly used among manufacturers and in that case these are sold by half price of those imported gypsum.

(4) Kiln furniture

Most of tile manufacturers use roller hearth kilns, thus not using sagger, setter plate, and pillars. New rollers for replacement are purchased through kiln manufacturers. Sanitary ware manufacturers mainly use setter plates and pillars that are made of mullite cordierite or SiC-based.

Saggers were used by tableware manufacturers in large quantities, mainly of mullite cordierite type. Imported saggers have been previously used, but large tableware manufacturers are now tending to make them in-house by using imported chamotte.

In future, more and more manufacturers will make saggers, setter plates, and pillars by themselves. While chamotte used in these kilns will eventually be localized, raw materials for mullite cordierite chamotte are kaolin, bauxite (Al_2O_3), alum shell, and magnesite some of which must be imported. Other local clay-based kiln furniture are used by small manufacturers.

Table 7-1 Use of Sub-materials for Ceramic Products Production

	Kiln Furniture					Glazing materials									
	Sagger	Support	Pillar	Transfer Paper	Gypsum Mold	Frit	Zircon	Pigment	Zinc Oxide	Premixed Glaze	Silica	Lime Stone	Feldspar	Kaoline	Ball Clay
Floor/Wall Tile															
Imported				✓		✓	✓	✓	✓				✓	✓	✓
Local w/imported materials					✓	✓									
Local				✓							✓	✓		✓	✓
Sanitary ware															
Imported		✓	✓				✓	✓	✓				✓		
Local w/imported materials		✓	✓		✓				✓						
Local											✓	✓		✓	
Tableware															
Imported	✓	✓	✓										✓		
Local w/imported materials	✓	✓	✓		✓										
Local				✓	✓						✓				
Novelties															
Imported															
Local w/imported materials					✓										
Local	✓	✓	✓		✓					✓	✓		✓	✓	

Note: ✓ mainly used.

Source: Field interview by the Study Team.

Table 7-2 (1) Specifications Sub-Materials by Manufacturers (Floor/Wall tile)

Sub-material	Raw material \ Factory	U-1	U-2	U-3	U-4	U-5	U-6	U-7	U-8	U-9	U-10
	Location	Tangerang W.J.	Tangerang W.J.	Belitung	Malang C.J.	Malang C.J.	Jakarta W.J.	Gresik E.J.	Tangerang W.J.	Tangerang W.J.	Bandung W.J.
	Product	Floor	F/W	Wall	Mosaic	Floor	F/W	Floor	Floor	Floor	F/W
Glaze	Feldspar				I. India	I. China	I. Thailand	I. Italy		I.	
	Kaolin			I.	D. Belitung	D. Belitung	I. Germany	I. & D.		I.	D. Belitung
	Clay			I.	I. U.K.	D. Kalimantan		I.		I. & D. U.K.	
	Silica			I.	D. Tubang	D. Tubang	D. Belitung				D. Belitung
	Lime			I.	D. Tubang	*3)	D. Pandarang				
	Talc										
	ZnO		I.			*3)				I.	I. Japan
	$BaCO_3$		I.							I.	I. China
	MgO										
	Zircon		I.		*2) I.Japan					I.	I. Japan
	Frit		I.Italy D.Ferro*1)	I. D. Part	I. Japan	*3)	I.Italy D.Part.			I. D. Part	D. Ferro
Ready Mixed glaze			I. Italy Spain								
Transfer paper								D. 2 Co.			
Pigment			I.	I.	I. Japan	*3)	I. Italy			I.	I. Taiwan

Notes: *1) PT. ITASMALTINDO
*2) Japanese Manufacturer
*3) Supplier from Surabaya
I: Imported material
D: Domestic material

Source: Informations obtained by Study Team through the field survey

Table 7-2 (2) Specifications Sub-Materials by Manufacturers (Floor/Wall tile)

	Factory	U-1	U-2	U-3	U-4	U-5	U-6	U-7	U-8	U-9	U-10
	Location	Tangerang W.J.	Tangerang W.J.	Belitung	Malang	Malang	Jakarta W.J.	Gresik E.J.	Tangerang W.J.	Tangerang W.J.	Bandung C.J.
	Product	Floor	F/W	Wall	Mosaic	Floor	F/W	Floor	Floor	Floor	F/W
	Raw Material										
Transfer Method	Transfer Paper	No	No	No	No	No	No	I. *2)	No	No	No
	Direct Silk Printing	Yes	Yes			I. China	Yes				Yes
Mold	Pigment	No	No	No	No	No	No	No	No	No	No
	Casting	No	No	No	No	No	No	No	No	No	No
Kiln Furniture	Roller Hearth Kiln	Yes	Yes			Yes	Yes	Yes	Yes	Yes	Yes
	Sagger	No	No	D.	I. Korea Mullite codelite	No	No	No	No	No	No
	Setter	No	No	I.Holland Mullite based		No	No	No	No	No	No
	Pillar	No	No	I. Mullite based		No	No	No	No	No	No
	Refractory			I. *1) Mullite based							

Notes: *1) From LOKA I.: Imported raw material

*2) From local 2 companies D.: Domestic raw material

Source: Informations obtained by Study Team through the field survey

Table 7-3 (1) Specifications of Sub-Materials by Manufacturers (Sanitary ware, Tableware and Others)

Raw Material	Factory	S-1	S-2	S-3	T-1	T-2	T-3	T-3	P-1	A-1	A-2	A-8
	Location	W.J.	Malang	W.J.	W.J.	W.J.	C.J.	W.J.	C.J.	W.J.	C.J.	W.J.
	Products	Sanitary	Sanitary	Sanitary	Tableware	Tableware	Tableware	Tableware	Ready-mix	Artware	Artware	Tableware
	Quality of Products	High	Low	High	Medium	Medium	Medium	Medium	-	-	-	-
Glaze	Feldspar	I. Australia	I. China		I. Japan, India	I.			D. Blitar			
	Kaolin	D.	D. Belitung			D. Sumatra			D. Blitar			
	Silica	D.			D. Bangka	D.			D. Tubang			
	Lime	D.	D. Malang			D.						
	Talc											
	ZnO	D.	I.									
	$BaCO_3$	I.										
	MgO								I. U.S.			
	Zircon	I.	I. U.K.									
	Frit											
	Pigment	I.	I. China	I. U.K.								
	Ready Mix					D.				D.	D.*1)	D.

Notes: *1) From UPT LIK, and Technical Service Unit in Malang
I: Imported Material
D: Domestic Material

Source: Informations obtained by Study Team through the field survey

Table 7-3 (2) Specifications of Sub-Materials by Manufacturers (Sanitary ware, Tableware, and Others)

Sub-material	Factory	S-1	S-2	S-3	T-1	T-2	T-3	T-4	A-1	A-2	A-3
	Location	W.J.	C.J.	W.J.	W.J.	W.J.	C.J.	W.J.	W.J.	C.J.	W.J.
	Product	Sanitary	Sanitary	Sanitary	Tableware	Tableware	Tableware	Tableware	Artware	Artware	Artware
	Quality of Products	High	Low	High	Medium	Medium	Low	Medium	-	-	-
Transfer Method	Transfer Paper	No	No		D. *2)	D. Local	Own made	Own made	No	No	No
	Direct	No	No		Yes						No
Mold	Pigment	I. France	I. German	I. Thailand	I.*1) France	D *4)	I. German	I.			I. Thailand
	Casting	Own made	Own made	Own made	Own made	Own made			Purchased	Own made	Own made
Kiln Furniture	Sagger	No	No		I. Japan, Thailand*3) Mullite codellite	D. Own made, Clay	Own made	Own made			D. Own made, Clay
	Setter Plates	I. Germany Mullite codellite	I. Germany Mullite codellite			Own made, Clay	I. Germany, Taiwan	Own made			D. Own made, Clay
	Pillar	I. Germany Mullite codellite	D. Own made, Clay				Own made	Own made			

Notes: *1) France (La Farge)
*2) Joint venture company with Korea
*3) Joint venture company with Germany and Thailand
*4) Lucky and Sango are own made.
I. Imported material, D. Domestic material

Source: Informations obtained by Study Team through the field survey

Table 7-4 Consumption of Sub-materials for Ceramic Products Production

(Unit: Rp. billion)

	For tile (*3)				For tableware (*4)			
	Imports	% of total	Local	Total	Imports	% of total	Local	Total
Sagger	0.967	100.0	0.000	0.967	0.000	–	0.000	0.000
Transfer paper	0.001	100.0	0.000	0.001	3.216	62.7	1.911	5.127
Gypsum	0.763	92.7	0.060	0.823	3.808	88.5	0.497	4.305
Glazing materials (*5)								
Frit	27.950	95.5	1.332	29.282	0.156	100.0	0.000	0.156
Zirconium	3.552	85.7	0.592	4.144	0.415	97.0	0.013	0.428
Zinc oxide	0.010	1.5	0.668	0.678	0.015	5.3	0.268	0.283
Pigment & chemicals	8.750	81.8	1.945	10.695	1.890	93.9	0.122	2.012
Total	41.993	90.1	4.597	46.590	9.500	77.2	2.811	12.311
Total raw materials used (*1)	92.466	62.1	56.417	148.883	23.849	57.1	17.923	41.772
Total production (*2)				645.100				131.500

Notes: (*1) Including others.

(*2) Total value of production reported.

(*3) Industry code: 36112

(*4) Industry code: 36111

(*5) Industrial materials only.

Source: BPS, Large and Medium Industrial Statistics, 1993.