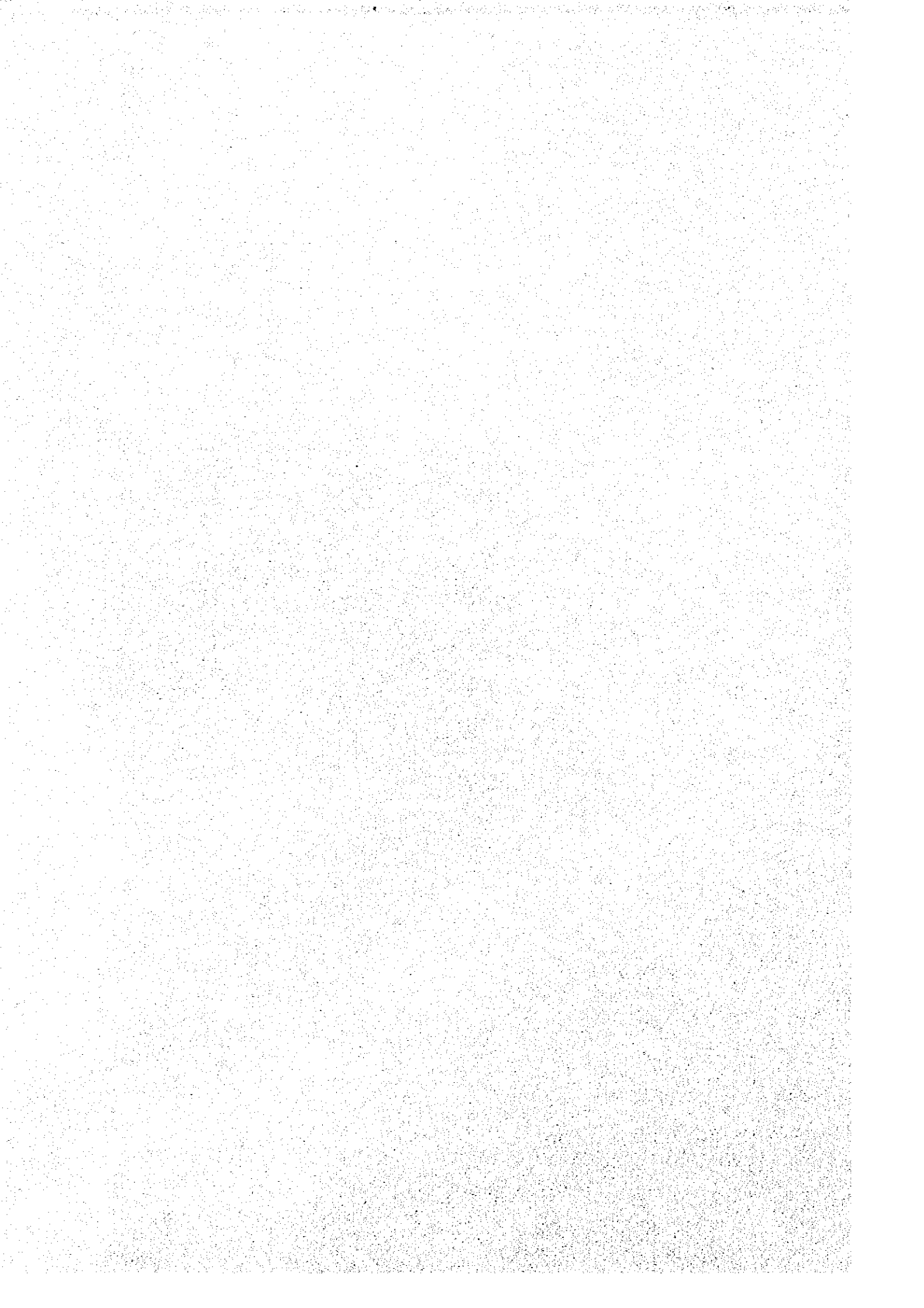


CHAPTER 2 CONTENTS OF THE PROJECT



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2-1 Objectives of the Project

The Papua New Guinea University of Technology was established aiming at education and research on an international level to advance science and technology in Papua New Guinea and the South Pacific region. About 300 students graduate every year. The University has produced about 5300 graduates since its inception and they are playing crucially important roles in the development of the country. However, the reliance on expatriate experts and engineers in all walks of life in the country has not yet been reduced. In order to allay the reliance the University has formulated a plan to improve the quality of education, research, community development and staff training, entitled "Development Objective and Strategies 1994 - 2000", in line with the National Higher Education Plan developed by the Commission for Higher Education. The National Higher Education Plan has linked the three principles of the Constitution which indicate the social purposes of the education system to national goals in the following manner:

- To educate to the highest level attainable the technologists, administrators, health, social and economic development professionals, teachers, scientists and artists required by a sovereign and self-reliant nation.
- To make possible the research and production activities that enable economic growth - based upon the rational use of the environment and of our natural resources
- To stimulate and carry out a process of critical assessment of Papua New Guinean social, political, cultural and economic institutions in the light of traditional values

The University's plan for expansion of facilities and educational equipment, provision of support services, strengthening of affiliated colleges is incorporated into the

Public Investment Programme. However, the recent Government budget constraints has impeded the provision of funds enough to materialize these objectives. Under the circumstances the University has requested the Japanese Government for a Grant Aid for the provision of educational equipment that is urgently needed.

This Project will renew worn-out equipment, complement existing equipment and introduce new equipment at the Papua New Guinea University of Technology, the highest educational institution of technology in PNG in order to improve, expand and renovate its educational activities to meet the requirements of the society. The Project aims at contributing to a rise in the standard of living and the social stability of PNG through producing professionals who can play leading roles in agricultural, mining, manufacturing and service industries, public organizations, and educational and research institutions, and advancing localization of professional in all walks of life.

2-2 Basic Concepts of the Project

(1) Basic Concepts

Educational equipment at the Papua New Guinea University of Technology is rather worn out and not enough in quantity. The Project aims at producing competent professionals mentioned in the national economic development policy and the national higher education plan and strengthening agricultural, mining and manufacturing sectors that constitute the basis of the economy of the country. It is one of the most important objectives of the Government to build up a self-reliant economy through advancing localization of professionals in the public as well as the private sector. The Project plans to provide educational equipment to be used in laboratories and facilities of the University and to improve the educational activities and the technology. The first priority is given to renewal of worn-out and obsolete equipment and addition of equipment that is insufficient in quantity. New kinds of equipment should meet the curriculum requirements.

Approximately seventy percent of the teaching staff are expatriates. The national staff are those who received higher education in advanced countries (especially Australia). The accreditation is based on that of Australia. For these reasons the

equipment currently used in the University seems rather sophisticated compared with those used in the universities of other developing countries. The present technical level of the University will be maintained even after most of the teaching posts currently occupied by the expatriates will have been filled with Papua New Guinean teachers in the future. The teaching staff not only do research but also participate in community development services (as advisers to public organizations, members of various professional associations, contracting researchers, etc.). They have good cooperation with government organizations and industries and conduct relatively advanced research. Employers of the graduates (public organizations and private companies) are using sophisticated equipment and ask for the capability of using such equipment from the graduates. This Project has selected equipment that is necessary to train students in technology required by employers and is in accord with the curriculum.

Those who use equipment selected for the Project are about one hundred sixty teaching staff and approximately two thousand students (in degree, diploma and postgraduate courses). About two hundred technical officers operate and maintain equipment. Twenty to thirty students are grouped into one laboratory class although there is difference from department to department. Due to insufficient quantity of equipment the size of class is often adjusted to the available quantity of equipment. The University is attentive to ensuring enough quantity of experimental equipment so that every student can conduct hands-on experiments. In principle the number of units of equipment is decided so that each student in a class can use equipment by himself.

The requested equipment was assessed in view of the criteria mentioned above.

(2) Assessment of the Request

The initial request from the University was made in 1994. Since then, there have been donations of equipment from private companies, changes of curriculum, reorganizations of courses, failure of existing equipment and changes of estimated prices of equipment due to the devaluation of Kina. These factors forced the University to amend the original request. A revised list of equipment was presented to the Basic Design Study Team when it visited the University in November 1996. The number of items have increased from 357 to 522. A new proposal of electric railway laboratory

was declined in consultation with the University because the contents of the proposal was not in accord with the purpose of the Project.

In the discussions with each Department such equipment as follows was excluded: duplication of the same type of equipment ; equipment that is difficult to maintain; equipment which functions can be performed by another type of equipment; and equipment of low priority in the curriculum. The specifications were modified to dispense with less important functions. In view of heavy use by students durability is one component in the selection of equipment. New addition in the request arisen during discussions with teaching staff was included if only it proved to be justifiable.

Based on these criteria of selection the consultant has selected equipment to be provided under this Project excluding one that does not meet the requirements. The selected items of equipment include scientific experimental equipment, analytical instruments, measurement instruments, computers and supportive equipment. In the selection of individual items, the following points were taken into consideration:

1. To be used for the experiments, practice and projects of students.
2. To be able to be used in research experiments by postgraduate students.
3. To meet the accreditation of PNG.
4. Quantity of equipment to be used in the service courses.
5. Number of teaching staff and technical officers.
6. To conform to the curriculum.
7. Knowledge and skills required for graduates.
8. Equipment that is used in a work place after graduation.
9. Equipment to be used in experiments to give intellectual stimuli to students.

The remaining part of the section outlines the selected equipment for each Department. On the average a laboratory class consists of 20 students. The quantity of equipment depends on how it is used: one to each student such as microscopes and computers; one to be used by 2 or 3 students; and one to be used for demonstration.

A. Department of Civil Engineering

The Department offers a degree course of four years leading to the degree of Bachelor of Engineering in Civil Engineering. The first year is the Foundation Year common to all the Engineering Departments : the Department of Electrical and Communication Engineering, the Department of Mechanical Engineering and the Department of Mining Engineering. The University also awards an undergraduate Diploma in Civil Engineering to students who complete the first two years of the normal Bachelor degree course and satisfy the examination. The number of students in the Foundation Year is 169 in 1996. The number of students of the Department (in the 2nd, 3rd and 4th year) is 117 in 1996. The students learn hydraulic engineering, public health engineering, traffic and pavement engineering, structure engineering and engineering management. The graduates are usually employed by Department of Works, Electricity Commission, National Housing Corporation, Department of Transport, Harbours Board, Department of Public Health, Bureau of Water Resources, Provincial governments, Local governments, University and Technical Colleges. There are 10 teaching staff members and 16 technical officers.

The Transportation Engineering Laboratory requested the following equipment:

- a) Complete sets of 1:2500 and 1:100,000 maps and aerial photographs of Papua New Guinea that are required to transportation planning and detailed design of roads.
- b) A reprographic machine to reproduce topographic maps and plans.
- c) personal computers, software for cost-benefit analysis and for road design and drawing, and a plotter.
- d) Radar speed meters and a time lapse camera for traffic accident studies.
- e) Instruments to measure traffic volumes.
- f) Benkelman beams to estimate the residual strength of pavement.
- g) Portable axle weighing machines for axle loading on road pavements.
- h) Global positioning systems (GPS) for field determination of latitude and longitude.

Of these, a), e) and f) have been dropped from the request list for the following reasons: the maps and aerial photographs may be borrowed from the

government authorities; instruments to measure traffic volumes may be borrowed from the police; and Benkelman beams exist although old.

Five personal computers and software of the calculation of civil engineering work will be provided. These computers are used for survey data processing, cost estimates of works and project management, especially in the project in the fourth year.

The following equipment was requested for geotechnics, concrete and bituminous materials testing: plate loading apparatus, a Los Angeles abrasion testing machine, a nuclear density meter and a Rowe cell. All will be provided except a Rowe cell which was withdrawn from the request.

Structural engineering requested a strain indicator and load cell, an oscilloscope, a hydraulic actuator and a data logger. The oscilloscope and the hydraulic actuator were dropped from the list because of their low priority.

Public health engineering requested equipment to investigate environmental pollution, especially water pollution; microscopes, an analytical balance, a field testing kit, a turbidity meter, an autoclave, a portable microbiological laboratory, a hydrolab and a COD digester. Of these items, the field testing kit and the turbidity meter were deleted from the request because the hydrolab would substitute for them.

The Hydraulic Laboratory requested to replace the impeller of the turbine since the existing one is highly corroded. However, the consultant requested to drop this request for the reason that it is difficult to purchase only part of the existing machine under the scheme of this Project.

All selected items are fundamental and important equipment in civil engineering. Besides these items, the Department requested a projector and recorder, a photocopier and a laser jet printer. The projector and recorder is for the video cassettes and teaching aids provided by the UNDP and the International Ferrocement Association. The consultant recommended a TV/VTR set instead of the projector/recorder since the TV/VTR set would be more convenient to handle.

B. Department of Electrical and Communication Engineering

The Department offers a four-year Degree course in Electrical Engineering, a three-year Diploma course in Electrical Engineering and a

Master course in propagation studies, control engineering and instrumentation. The first year of the Degree course is the Foundation Year common to other Engineering Departments; Civil Engineering, Mechanical Engineering and Mining Engineering. The fourth year students of the degree course select either the Communication Option or the Power Option. During the vacations at the end of each year the students are expected to take employment with sponsors or organizations that deal in some aspect of electrical and communication engineering. The students are required to accumulate at least ten weeks vacation training experience. Many graduates get jobs with Post and Telecommunication Corporation, the Electricity Commission, National Broadcasting Commission, Office of Civil Aviation, Department of Works and the mining industry. In the third year of the Diploma course, students have two options; the Communication Option and the Electronics Option. The number of students is 158 in 1996. There are 11 teaching staff and 15 technical officers.

The requested items are equipment to learn power engineering, measuring instruments (oscilloscopes, ammeters, voltmeter etc.), experimental equipment (power sources, signal generators etc.) and computers to learn computer engineering and its applications. Four pieces of equipment necessary to learn the fundamentals of power engineering and its applications such as motors and transformers will be provided so that a group of 2 or 3 students may conduct experiments with one set each in a laboratory class. The selected items are assembly kits of power electronics basic equipment, assembly kits of drive controls, assembly kits of phase angle control and so on. Other power engineering equipment will be provided one piece each for demonstration experiments.

The measuring instruments are requested to replace the existing worn-out ones. The quantity is arranged so that one or two students can use one instrument in a laboratory class. The selected items are ammeters, voltmeters, oscilloscopes, signal generators, frequency counters, power sources and so on.

Computer systems are requested from the Multi-media Training Laboratory, the Network and Unix Laboratory, the Data Communication Laboratory and for the Staff Network and E-Mail Connectivity. The Department requests these computer systems for the reason that the students must be trained in not only the development of computer systems but also the development of network. The consultant has combined systems in the four

laboratories into a system of one laboratory by restructuring the network in view that the training in electronic exchange systems, networks and data communication is indispensable. The selected items are 3 engineering work stations, 15 personal computers, data communication control equipment such as modems, packet switching devices, basic software for networking and communication protocol.

The Department also requested equipment related to a project that plans to construct an experimental railway on the campus of the University for the preparatory study of railway construction in Papua New Guinea. However, this proposal is considered to be out of the scheme of this Project and has been declined.

C. Department of Mechanical Engineering

The Department offers a four-year degree course leading to the Bachelor of Engineering in Mechanical Engineering. The first year is the Foundation Year common to all the Engineering Departments : the Department of Civil Engineering, the Department of Electrical and Communication Engineering and the Department of Mining Engineering. The second and third year consist of the studies in thermofluids, applied mechanics, engineering materials, drawing and design, manufacturing processes and their applications. The fourth year consists of more advanced studies in thermofluids, applied mechanics, drawing and design with studies in manufacturing technology and industrial engineering. The students are required to accumulate at least twelve weeks of practical industrial training during their vacations. Besides the degree course, the Department offers a one-year postgraduate diploma course in Energy Engineering and a two-year master course in Mechanical Engineering. The graduates are employed in the fields of manufacturing, power, mining, agriculture, maintenance of plant and machinery, transport, rural and community development. The number of students is 127 in 1996. There are 9 teaching staff and 11 technical officers.

The Department requested 20 kinds of equipment. As the result of discussion with the teaching staff, the following equipment was deleted from the request: drafting machines, computers, a CD-ROM recorder, a UPS, a projector,

a hybrid temperature recorder and a scanning machine. The drafting machines were intended to be replaced. However, the existing ones are still workable. The computers, CD-ROM recorder, UPS and projector will be provided by the Australian government. The hybrid temperature recorder and scanning machine will be purchased by the University's own funds.

The selected equipment is as follows: a lathe machine (addition to the existing five machines); a FFT spectrum analyzer (instead of a set of sound meter, spectrum analyzer and recorder); a universal testing machine; test equipment to be used in the workshop; a refrigeration test bench; a gas turbine; an air-conditioning bench; a heat transfer bench; a Brinell hardness testing machine (to test the hardness of engineering materials); a microscope fitted with a video camera (to observe microstructure of materials); an electric discharge machine (EDM); and CAD software. Nowadays a mechanical engineer is required to be able to draw a design using CAD. At present the Department has very few software for computer-aided engineering drawing and design. There is a gap in the skills in CAD required by the industry and the present ones of student. The Department is urgently needed to be equipped with CAD software that is currently used in the industry. As seen from the above list of equipment, the almost all items selected are used in the practice of machine tools, the testing of machines and engineering materials, and thermodynamics experiments.

D. Department of Surveying and Land Studies

The Department offers the following courses:

a) Surveying

- A four-year degree course leading to a Bachelor of Surveying.
- A two-year diploma course leading to a Diploma of Surveying.

b) Cartography

- A four-year degree course leading to a Bachelor of Cartography.
- A two-year diploma course leading to a Diploma of Cartography.

c) Land Management

- A four-year degree course leading to a Bachelor of Land Studies.
- A one-year diploma course leading to a Diploma of Land Administration.

· A one-semester course leading to a Certificate in Land Administration.

The number of students is 173 in 1966. There are 8 teaching staff and 11 technical officers.

The surveying technology and cartography has been progressing rapidly in recent years as seen, for instance, in the precise determination of positions using GPS. In Papua New Guinea, the University is requested to play a leading role in the introduction of the latest technology in the public as well as the private sector. The students must be trained in the latest technology since they must work as a peer professional soon, say two years after the graduation. In these circumstances, the Department needs to have equipment that is used to teach the latest technology in surveying and cartography, not with conventional equipment.

The requested equipment was: global positioning systems (GPS); automated surveying systems, total stations and software; theodolites; surveying base equipment; image setter, GIS software, GIS workstations; upgrade to spatial information systems laboratory; hydrographic surveying base and some teaching aids. After a discussion with the Head of Department, the conventional surveying instruments were dropped from the request because the existing ones would still work. The hydrographic surveying base was also dropped due to its low priority in the study. The composition of automated surveying systems has been reorganized. The finally selected equipment is as follows: GPS; detail survey total stations; total stations; theodolites; levelling equipment; data loggers; surveying and mapping processing system (software, graphics workstation, image setter, spatial information systems); and UPS. The Department is the only institution that teaches GPS in Papua New Guinea. GPS has particular significance in PNG where much of the country is not suitable for traditional surveying techniques. The current need is for high precision GPS to complement the existing low precision equipment. The new GPS equipment is required to be compatible with the existing equipment to enable combined usage of all equipment and to enable automated real time processing of data. The GPS is also used for volcanic deformation monitoring, crustal motion studies and global earth movement studies (with Japanese and Australian universities).

Computers are indispensable to process measurement data collected by the current surveying equipment. Therefore it is necessary for the students to

learn computerized surveying techniques. For this purpose, 7 personal computers and a plotter have been selected. A network of 20 computers will be formed combining the new and existing computers. Software for producing maps from the data collected by surveying equipment was also selected. Such equipment as GPS, total stations, surveying and mapping processing systems is being used in the Department of Works.

E. Department of Mining Engineering

The Department offers a four-year degree course. The first year is the Foundation Year common to all the Engineering Departments : the Department of Civil Engineering, the Department of Electrical and Communication Engineering and the Department of Mechanical Engineering. In the second year the course is divided into two majors; Mining Engineering and Mineral Process Engineering. The mining and petroleum industry forms the backbone of Papua New Guinea's economy accounting for nearly 80 % of its export and approximately 15 % of the Government's total revenue. The number of students is 56. There are 7 teaching staff and 5 technical officers. The graduates are employed by Department of Minerals and Energy, National Works Authority, Electricity Commission, Bureau of Water Resources, Provincial governments, Local governments, Universities, Technical Colleges, mining companies, consulting companies, equipment sales companies and manufacturing companies. The Department's request accounts for the largest proportion in the Project since this Project was first proposed by the Department. The requested equipment is categorized into three kinds: mining engineering, mineral process engineering and computer systems. Equipment for mineral process engineering accounts for the largest amount.

The selected equipment for the Mining Engineering Laboratory is a universal testing machine, a core drill, a soft rock penetrometer and workstations. The universal testing machine of the capacity of 3000kN was first requested. However, as the result of discussion with the staff members, it turned out that 2000kN for compression and 300kN for tensile and bending would be enough and the specifications were modified to the effect. The mining planning and plant operation requires computer systems that can process

massive data and students in mining engineering need to learn the basic techniques of computerized data processing. Ten personal computers, three engineering workstations for processing massive data and a scanner have been selected.

The Mineral Process Engineering Laboratory requests 43 kinds of equipment: analytical instruments such as X-ray diffractometer, equipment for pyrometallurgy and hydrometallurgy, equipment for process technology, apparatus for chemical analyses. The major ones are an X-ray diffractometer system (XRD); a particle size distribution analyzer; a microphotometry system; spare lamps for XRD, X-ray fluorescence apparatus, and atomic absorption spectrophotometer; glassware for chemistry experiments; chemicals for chemistry experiments; process control equipment; a magnetic separator; an electrostatic separator; a muffle furnace and fume hood; fume scrubbers; an electric briquetting press and so on. The Mineral Process Engineering Laboratory is a leading analysis center in PNG and mineral process engineering is a priority subject of the Department. Since 1992, JICA has seconded Japanese experts in metallurgy and analytical chemistry to the Department under its technical cooperation scheme. The Department in cooperation with those Japanese experts selected equipment to be requested. All equipment requested by the Department is considered to be adequate and has been selected with some modifications of specifications. The selected equipment includes a photocopier that is necessary to produce a bulk of copies of teaching materials and a camera to produce color slides.

F. Department of Architecture and Building

There are two courses: architecture and building. The first semester in the first year is common to both courses. In the second year the students opt either the architecture course or the building course. After completion of the third year the successful students are awarded a diploma in either course. Students who want to study further proceed to the fourth year of the degree course. The students who complete the fifth year receive a degree of Bachelor of Architecture or a degree of Bachelor of Building. Beside these courses, there is a two-year post graduate diploma course that is offered with the first year

residence at the University of Papua New Guinea and the second year at Unitech. The programme provides training for planners in urban or rural development planning; environment planning; residential area planning; transportation and infrastructure planning. The total number of students is 126 in 1996. There are 13 teaching staff and 8 technical officers.

The Department requests equipment for drawing; equipment to be used in building science classes such as a solarimeter, a hydrometer etc.; and CAD systems. As the result of discussions with the staff members, the following equipment was selected: drawing boards; parallel drafting rules; whiteboards; TV sets; filing cabinets to store drawings; metal lockers for students to keep their drawing instruments; an air conditioner; a UPS; a digital camera; a copier; and CAD systems. Drawing boards are indispensable for students. The existing ones are old and worn out. They need to be replaced. The lockers and cabinets are for the students of building course. At present they do not have a place to keep plans they drew and their drawing instruments. The computer aided design in architecture and building engineering is now widely practiced. The students need to learn how to draw plans using computers, methods of structure calculation by computers, and methods of cost estimates. For these purposes, 25 personal computers, a plotter, a color scanner and software for architecture, cost estimates, project management and drawing and design were selected.

G. Department of Agriculture

The Department offers a four-year course leading to the Degree of Bachelor of Science in Agriculture. Beside the degree course, there is a one-year postgraduate diploma course in four areas of agricultural science: crop production, animal production, agricultural economics/extension and agricultural engineering. The number of degree course students is 116 in 1996. There are 13 teaching staff and 39 technical staff. The Department has a farm of 39 hectares on the University campus and a larger farm of about 300 hectares to be purchased and developed. The degree course students are required to undertake field training for a total of eighteen weeks.

The requested equipment is: 4 vehicles to transport students, farm machines and implements and agricultural chemicals to the farm; laboratory

equipment (27 items); computers; agricultural engineering teaching facilities (14 items); equipment in the agricultural engineering teaching workshop (17 items); agricultural surveying equipment (16 items); agriculture farm equipment (21 items); equipment for the agriculture biotechnology center (24 items); and office equipment.

Of these items, the following ones were deleted from the request list: a soil auger and Munsel charts for the laboratory; a post harvest laboratory for the agriculture engineering; a motor bike with trailer, a three-ton truck and a land cruiser for the farm; office equipment; and air conditioners, part of microscopes and a vehicle for the biotechnology center. The Department withdrew the request for the soil auger, Munsel charts and the post harvest laboratory because they are not urgently needed. The quantity of vehicles was reduced to one because it is difficult to provide three vehicles within the framework of this Project. Since almost all items are equipment that is used commonly in agriculture experiments and practice, they have been selected except for those mentioned above as deleted. The number of kinds of equipment selected is 111 (refer to the list of equipment to be provided). The major equipment selected is: a vehicle; fume hoods with acid extractors; acid resistant cupboards and extractors; microscopes; a video outfit for attachment to microscope; an illuminated cooled incubator; lighting accessories for greenhouse; growth chambers; a sheet metal guillotine machine; a metal bandsaw; a fertilizer spreader; a front end loader and so on. In Papua New Guinea, books on engineering are found only at the University book shops and books on agriculture particular to Papua New Guinea are rarely published. The Department needs to prepare teaching materials which teach students characteristic features of Papua New Guinea agriculture. Six personal computers, a printer and a scanner were selected to be used to prepare such materials.

H. Department of Forestry

The Department offers a five-year course leading to the degree of Bachelor of Science in Forestry and a two-year course leading to the degree of Bachelor of Forest management designed specifically for holders of a Diploma in

Forestry from the Bulolo Forestry College. The graduates are working in the National Forest Authority, Department of Environment and Conservation and forestry industries. The Department is the only institution in the South Pacific region which offers training in tropical forestry and accepts students from the South Pacific region. Emphasis is placed on forest management, on environmental protection, on undertaking resource surveys, on wood technology and on forest industries. The students are required to undergo one year of work experience in private industries or with the Department of Forests. The number of students is 63 in 1996. There are 5 teaching staff and 9 technical officers.

The Department requests microscopes to observe tree tissues in wood anatomy; a tractor with slasher for Omsis Forestry Station that the Department has permission to use from the National Forest Authority; digital balances; surveying compasses; a microtome and compactus units to keep plant specimens. All are indispensable for forestry studies. The existing microscopes are out of order. The quantity is arranged so that each student can use one microscope in a class of 20 students. Only one surveying compass is workable. Six compasses will be added to enable students to be trained in forest survey.

I. Department of Mathematics and Computer Science

The Department offers a four-year course leading to a Bachelor of Computer Science Degree. The course has a two-year plus two-year structure. Students enter a two year programme leading to a Diploma in Computer Science. Upon successful completion of the Diploma course, students may apply to the Bachelor Degree course of two years duration. The Diploma programme teaches operating systems, computer architecture and local area networks. The Degree course teaches computer hardware and software, system analysis, mathematical computation and computer modelling. The Department is the only institution that teaches computer science in Papua New Guinea. The programme started in 1993 with 15 students and was followed by an intake of 25 students in 1994, 35 in 1995 and 45 in 1996. The number of students is 85 in 1996. To meet the increasing need for computer science graduates in Papua New Guinea, the number of students must expand significantly with a larger intake in the near future. The number of teaching staff is 16 and the number of

technical officer is 5. The Department offers courses in Mathematics and Computing to students in all Degree and most Diploma courses throughout the University. On the average weekly hours of one subject are four to six. The number of the students in other Departments whom the Department teaches is as follows:

	Mathematics	Computer Science
First Year	527	103
Second Year	369	50
Third Year	85	25
Fourth Year	8	28

Besides the Department offers three Postgraduate Diploma Programmes: Engineering Mathematics, Mathematics and Computer Science. Equipment the Department needs is naturally computers. Most of the existing computers are old and worn out. Computers in the computer laboratories for the first and second year students will be renewed by the University's own funds. There are few computers which students in the third and fourth year and in the postgraduate course can use to learn the latest operating systems, interface shells and application software. The requested equipment is computer network systems for students and computers for demonstration use. Since the Department must teach computer related subjects to all students of the University, it is necessary to provide capable computer systems. The selected equipment is: 30 personal computers; a DOS file server; a UNIX file server; a printer; and software including compilers. In addition, one computer system (a computer, a scanner, a projector, a screen and mathematics software) was selected to demonstrate possibilities of computer.

J. Department of Business Studies

The Department offers four-year courses leading to the degree of Bachelor of Commerce and to the degree of Bachelor of Information Systems. Students enter a two-year Diploma course and upon successful completion of the Diploma

course may apply to enter the Bachelor degree course. The Diploma course is streamed into three areas: Accountancy, Management and personal computer Information Processing. Students then do two additional years leading to the Bachelor degree in either of the following four areas: Accountancy, Management, Information Systems and Business Economics. Beside these courses, the Department offers a Diploma in Computer Programming on a part time basis only over a period of 2 - 4 years. In the near future a programme of Master of Business Administration (MBA) will be started. Emphasis in the syllabus is placed on data processing by computers. Students are required to become conversant with not only general application programs in word processing, spreadsheet and database but also specialized application programs in accounting, cash flow, budget etc. In the course of Accountancy and Business Economics COBOL is taught and in the course of personal computer Information Processing, Information Systems and Computer Programming COBOL and PASCAL are taught. In Papua New Guinea there are many foreign capital companies and joint venture companies. Computerization in business is on a similar level as that of advanced industrialized countries. Under the circumstances graduates are required to be capable of using computer systems but also to have capability of constructing computer systems themselves. Thirty-nine subjects of the total 94 in the curriculum of the Department requires the use of computers in class. Most subjects in the course of personal computer Information Processing (Diploma course) and Information Systems (Degree course) need to use computers. About 30 - 40 % of the classes of Accountancy course use computers. The number of students of the Department is 408 in 1996, which is the largest throughout the University. Applicants for the Department are many and the competition rate is high. Against the intake of 143 in 1996, applicants of the first choice were more than 200 and the second choice were more than 250. It is difficult to enter the Department unless applicants achieve a good result in high schools. About 10 % of the intake is allotted to foreign students from the South Pacific region.

Graduates from the Information Systems course are employed mainly by computer companies. Graduates from the Accountancy course are employed by accounting firms, graduates from the Management course by business in general and graduates from the Business Economics by banks, Department of Finance, statutory bodies and private companies. Demands for graduates are well over

the supply. For instance, there are demands from 2 to 3 accounting firms for one graduate of accountancy. The number of teachers is 18 although the number of post is 30. Four graduates are studying abroad and are expected to fill some vacant posts in two or three years. There are 5 technical officers as well.

The requested equipment is: educational audiovisual equipment such as a projector and screen; equipment necessary for networking of computers within the Department; computers to prepare teaching materials; laptop computers for teachers; additional computers for students and renewal of the existing ones. Existing computers for students are 40 units and the request is additional 20 units. In a class related to computers at least students in the fourth year need to use one computer each and in the first, second and third year one computer for at most two students. Since there are 408 students in total, at least 60 computers are required. The teaching staff need computers to prepare teaching materials for these classes.

The Department also requested laptop computers to enable teachers to carry the teaching materials they prepared to the classrooms and use them in the lectures. However, this proposal was declined since the teaching materials prepared with teacher's computer can be carried in floppy disks and used with a computer in a classroom. Taking into consideration these situations, twenty computers for students, a printer, a plotter and fifteen computers for teachers to prepare teaching materials have been selected.

K. Department of Applied Physics

The Department offers a four-year degree course entitled "Bachelor of Science in Applied Physics with Electronics and Instrumentation". It is designed to produce graduates with technical skills in electronics and instrumentation, together with a good understanding of the underlying physical principles. This is the only institution to give such training in Papua New Guinea and in the South Pacific region. Graduates are employed by manufacturing industries, service industries, government laboratories and hospitals. The number of students is 24 in 1996. There are 10 teaching staff and 16 technical officers.

The Department is equipped with function generators, oscilloscopes, spectrometers etc., but with few instruments for physics proper experiments.

The requested equipment is 13 items that are used in basic experiments in the courses of atomic physics, electronics and solid state physics that started in 1995. The major equipment is an electron spin resonance system, a PMT detection system, Franck-Hertz experiment apparatus, Milikan apparatus and Hall effect equipment.

The Department is also responsible for the teaching of physics to the first year students in all 11 science based departments of the University (Agriculture, Applied Sciences, Architecture and Building, Civil Engineering, Electrical and Communication Engineering, Mechanical Engineering, Mining Engineering, Mathematics and Computer Science, and Forestry).

L. Department of Applied Sciences

The Department offers three four-year degree courses leading to i) Bachelor of Science in Applied Chemistry, ii) Bachelor of Science in Food Technology and iii) Bachelor of Science in Human Nutrition. Applied Chemistry course carries out analyses, testing and investigation into a wide range of materials. Food Technology course studies production, processing, preservation, distribution and utilization of food. Human Nutrition course deals with many aspects of food and health. The first year of each course is devoted to common foundation subjects such as biology, physics, chemistry and mathematics. Applied chemistry places emphasis on natural products chemistry. Natural product chemistry gives excellent training to students in practical techniques of isolation and purification from complex mixtures and in instrumental techniques. Many natural materials unique to PNG has economic implications. The number of student is 137. There are 8 teaching staff and 9 technical officers.

The requested equipment is widely used in the studies of food technology, environmental chemistry and medicinal plants. All the requested items will be provided since they are considered adequate for the Department. The major items are a photomicrograph system, a polarograph and an atomic absorption spectrophotometer.

The Department is also responsible for the teaching of chemistry to Agriculture, Forestry, Applied Physics and Engineering students.

M. Department of Language and Communication Studies

The Department teaches languages and communication skills to students in most degree and diploma courses. The major objectives are to provide students with necessary skills and knowledge to work in the present society such as communication skills, research skills, writing a research paper, communication in the work place, negotiation skills, Melanesian society and politics, Papua New Guinea languages and communication, principles of translation and interpretation, public and community relations, media studies etc. The Department also offers four professional courses in Communication for Development: a certificate course lasting one semester, an associated diploma course lasting one year, a diploma course lasting two years and a degree course lasting four years. The number of students in the professional courses is 24 in 1996. There are 8 teaching staff and 5 technical staff.

Language and communication skills training have been practiced using language laboratories. However, language technological support moves on from language laboratory methods to computer assisted language learning that is recognized far more effective than conventional language laboratory methods. It is by now evident that CD-ROM, E-mail, WWW and Internet have substantially greater language-pedagogical potential than the limited applications available in language laboratories. The Department has decided to shift from the teaching in language laboratories to Computer Assisted Language Learning (CALL). Software produced by Oxford University Press, Cambridge University Press and Longman Australia will be required for CALL. The requested equipment is above mentioned software and computers that can run these programs. A network consisting of twenty-five personal computers and a printer as well as the above mentioned software were selected.

N. Computer Services Centre

The Computer Services Centre is responsible for computers in its own office and in the six computer laboratories of common use. The Centre itself does not perform teaching activities. All software maintenance is done by one

academic and 4 technical staff of the Centre. All hardware maintenance is performed by the Electronic Services Unit. The teaching on how to use computers is conducted by the teaching staff of the Department of Mathematics and Computer Science, and other departments whenever necessary. The six computer laboratories of common use are located in Sandover, Mathematics, Mechanical Engineering (now empty), Tololo 1, Tololo 2 and Business Studies buildings. Computer in these laboratories are used by students in the lower grades for learning computer operations in general. Students can not afford a computer themselves. Students can use computers in these laboratories after school hours. On the other hand, computers maintained by other departments are used by upper grade students for the studies in their subject fields such as numerical analysis, CAD, structure analysis, accounting etc. Graduates from the University will work in a place where computers are used in daily work and are expected to have basic knowledge and skills in computer operations. Therefore subjects related to computer operations take a greater part in the curriculum. Table 3-1 lists the subjects related to computers in the curriculum. In the Table, subjects of the code number of 100s and 200s are taught in the first and second year respectively.

The request is: provision of a new networked computer laboratory in the Mechanical Engineering building; replacement of three existing networked computer laboratories in Sandover, Mathematics and Civil Engineering buildings; and equipment for University E-mail and Internet services. The selected equipment is: 20 personal computers, a printer and a display projector for four computer laboratories each, and an engineering workstation, a printer and network switches for University E-mail and Internet services. The computer system for University E-mail and Internet services will be used for management and gathering of science and technology information.

The university has a plan to construct a computer network covering the whole University using optical fibres, although the plan is not included in this Project.

Table 3-1. Computer-related Courses (1/3)

Course No.	Course Name	Dept. of Applied Sciences			Dept. of Applied Sciences			Dept. of Applied Sciences			Dept. of Applied Sciences			Dept. of Applied Sciences			Dept. of Applied Sciences			Dept. of Applied Sciences		
		1	2	3	1	2	3	1	2	3	1	2	3	1	2	3	1	2	3	1	2	3
AS 272	COMPUTER IN ARTS/HUMANITIES																					
AS 273	APPLIED MATHEMATICS I																					
AS 274	APPLIED MATHEMATICS II																					
AS 275	APPLIED MATHEMATICS III																					
AS 276	APPLIED MATHEMATICS IV																					
AS 277	APPLIED MATHEMATICS V																					
AS 278	APPLIED MATHEMATICS VI																					
AS 279	APPLIED MATHEMATICS VII																					
AS 280	APPLIED MATHEMATICS VIII																					
AS 281	APPLIED MATHEMATICS IX																					
AS 282	APPLIED MATHEMATICS X																					
AS 283	APPLIED MATHEMATICS XI																					
AS 284	APPLIED MATHEMATICS XII																					
AS 285	APPLIED MATHEMATICS XIII																					
AS 286	APPLIED MATHEMATICS XIV																					
AS 287	APPLIED MATHEMATICS XV																					
AS 288	APPLIED MATHEMATICS XVI																					
AS 289	APPLIED MATHEMATICS XVII																					
AS 290	APPLIED MATHEMATICS XVIII																					
AS 291	APPLIED MATHEMATICS XIX																					
AS 292	APPLIED MATHEMATICS XX																					
AS 293	APPLIED MATHEMATICS XXI																					
AS 294	APPLIED MATHEMATICS XXII																					
AS 295	APPLIED MATHEMATICS XXIII																					
AS 296	APPLIED MATHEMATICS XXIV																					
AS 297	APPLIED MATHEMATICS XXV																					
AS 298	APPLIED MATHEMATICS XXVI																					
AS 299	APPLIED MATHEMATICS XXVII																					
AS 300	APPLIED MATHEMATICS XXVIII																					
AS 301	APPLIED MATHEMATICS XXIX																					
AS 302	APPLIED MATHEMATICS XXX																					
AS 303	APPLIED MATHEMATICS XXXI																					
AS 304	APPLIED MATHEMATICS XXXII																					
AS 305	APPLIED MATHEMATICS XXXIII																					
AS 306	APPLIED MATHEMATICS XXXIV																					
AS 307	APPLIED MATHEMATICS XXXV																					
AS 308	APPLIED MATHEMATICS XXXVI																					
AS 309	APPLIED MATHEMATICS XXXVII																					
AS 310	APPLIED MATHEMATICS XXXVIII																					
AS 311	APPLIED MATHEMATICS XXXIX																					
AS 312	APPLIED MATHEMATICS XL																					
AS 313	APPLIED MATHEMATICS XLI																					
AS 314	APPLIED MATHEMATICS XLII																					
AS 315	APPLIED MATHEMATICS XLIII																					
AS 316	APPLIED MATHEMATICS XLIV																					
AS 317	APPLIED MATHEMATICS XLV																					
AS 318	APPLIED MATHEMATICS XLVI																					
AS 319	APPLIED MATHEMATICS XLVII																					
AS 320	APPLIED MATHEMATICS XLVIII																					
AS 321	APPLIED MATHEMATICS XLIX																					
AS 322	APPLIED MATHEMATICS L																					
AS 323	APPLIED MATHEMATICS LI																					
AS 324	APPLIED MATHEMATICS LII																					
AS 325	APPLIED MATHEMATICS LIII																					
AS 326	APPLIED MATHEMATICS LIV																					
AS 327	APPLIED MATHEMATICS LV																					
AS 328	APPLIED MATHEMATICS LVI																					
AS 329	APPLIED MATHEMATICS LVII																					
AS 330	APPLIED MATHEMATICS LVIII																					
AS 331	APPLIED MATHEMATICS LIX																					
AS 332	APPLIED MATHEMATICS LX																					
AS 333	APPLIED MATHEMATICS LXI																					
AS 334	APPLIED MATHEMATICS LXII																					
AS 335	APPLIED MATHEMATICS LXIII																					
AS 336	APPLIED MATHEMATICS LXIV																					
AS 337	APPLIED MATHEMATICS LXV																					
AS 338	APPLIED MATHEMATICS LXVI																					
AS 339	APPLIED MATHEMATICS LXVII																					
AS 340	APPLIED MATHEMATICS LXVIII																					
AS 341	APPLIED MATHEMATICS LXIX																					
AS 342	APPLIED MATHEMATICS LXX																					
AS 343	APPLIED MATHEMATICS LXXI																					
AS 344	APPLIED MATHEMATICS LXXII																					
AS 345	APPLIED MATHEMATICS LXXIII																					
AS 346	APPLIED MATHEMATICS LXXIV																					
AS 347	APPLIED MATHEMATICS LXXV																					
AS 348	APPLIED MATHEMATICS LXXVI																					
AS 349	APPLIED MATHEMATICS LXXVII																					
AS 350	APPLIED MATHEMATICS LXXVIII																					
AS 351	APPLIED MATHEMATICS LXXIX																					
AS 352	APPLIED MATHEMATICS LXXX																					
AS 353	APPLIED MATHEMATICS LXXXI																					
AS 354	APPLIED MATHEMATICS LXXXII																					
AS 355	APPLIED MATHEMATICS LXXXIII																					
AS 356	APPLIED MATHEMATICS LXXXIV																					
AS 357	APPLIED MATHEMATICS LXXXV																					
AS 358	APPLIED MATHEMATICS LXXXVI																					
AS 359	APPLIED MATHEMATICS LXXXVII																					
AS 360	APPLIED MATHEMATICS LXXXVIII																					
AS 361	APPLIED MATHEMATICS LXXXIX																					
AS 362	APPLIED MATHEMATICS LXXXX																					
AS 363	APPLIED MATHEMATICS LXXXXI																					
AS 364	APPLIED MATHEMATICS LXXXXII																					
AS 365	APPLIED MATHEMATICS LXXXXIII																					
AS 366	APPLIED MATHEMATICS LXXXXIV																					
AS 367	APPLIED MATHEMATICS LXXXXV																					
AS 368	APPLIED MATHEMATICS LXXXXVI																					
AS 369	APPLIED MATHEMATICS LXXXXVII																					

O. Vudal University College

The College offers a three-year course leading to a Diploma in tropical Agriculture. The main objective of the College is to produce middle-level agricultural professionals. About one-third of the instructional time is devoted to the study of biological, physical and social sciences and two-thirds to the study of agricultural production and rural development. The number of students is 125 in 1996. There are 15 teaching staff and 40 technical staff.

There are a farm of 120 hectares, classrooms and laboratories on the campus of 250 hectares. The farm includes five production farms of cattle, pigs, poultry, tree crops and dry field crops; a farm for demonstration; an agricultural machine workshop; a farm management office; and a cocoa plantation of 30 hectares and a pasture of 90 hectares.

The request includes equipment to be used in laboratories such as microscopes, measuring instruments, balances, analytical instruments, stop watches and lenses; projectors to be used in the classrooms; a weather station; a bus to transport students and a single cab utility; desks and chairs in the classrooms and dormitories; textbooks and reference materials for the library; a tractor, a rice thrasher, a rice polisher, a sprayer, small machines and tools; a fix thicknesser, a fixed rip saw, tools for the maintenance of farm machines and vehicles, communication equipment, office equipment; welders, generators, machine tools, tools, surveying equipment.

Of these items, the double cabin truck and books for the library were deleted because of the low priority and not in accord with the purpose of this Project. The desks and chairs were also deleted because the College would be able to produce them using machine tools and tools to be provided to the workshop. The quantity of microscopes, balances, fume hoods and tractors was reduced to the bare minimum. The bus to transport students was changed to a 25 seater from a 30 seater.

Twenty computers for students, four computers for teachers, one computer for analysis of experimental data and one computer for the library were requested. Of these, the computers for students and teachers have already been ordered using the College budget and they have been deleted from the request. A computer for analysis of experimental data and one for

administration are included in the selected equipment since they are indispensable for the evaluation of students' performance.

2-3 Basic Design

2-3-1 Design Concept

(1) Basic Policy

The request was carefully reviewed and discussed with the teaching staff of the University. The basic policy on the design of the Project has been set as follows.

1) Equipment of high priority

- Renewal of equipment that does not function well due to the deterioration or does not work due to breakdown.
- Addition of equipment that is insufficient in quantity for training of students.
- Equipment that is necessary in view of the curriculum and the University does not have.

2) Equipment of low priority

- Sophisticated equipment that is used for only highly advanced research.
- Equipment that is difficult to be installed or to be used due to lack of infrastructures.
- Equipment that is rarely used and extremely expensive.
- Equipment, the spare parts and consumables of which are difficult to be obtained.

The criteria for the quality and specifications of equipment are set as follows:

- a. To be adequate for university education (degree, diploma and postgraduate courses).
- b. To be in accord with the curriculum and accreditation.
- c. To minimize the costs of operation and maintenance.

- d. To be in accord with the standards and legal requirements of PNG.
- e. For the specifications not to indicate a product of a specified manufacturer.
- f. Not to contaminate the environment or to be equipped with measures to protect the environment.
- g. To take into consideration expansion of functions in future unless the price becomes much too expensive.

(2) Other Considerations

The following points are taken into consideration in the selection of equipment in view of the infrastructures at the Project site.

- 1) An uninterruptible power supply (UPS) of appropriate capacity is combined with the relatively expensive equipment that has memories and is used for relatively long duration.
- 2) An automated voltage regulator (AVR) of appropriate capacity is combined with the equipment that is easily damaged by voltage fluctuations (about +/-10%) and is not repairable in PNG in a short time.
- 3) An air conditioner of appropriate capacity is provided for the laboratory in which the expensive equipment that must be operated for long duration at constant temperature is installed.
- 4) Spare parts that are to be replaced in about two years are provided with major equipment.

(3) Policy on the Places of Procurement

The convenience of effective utilization and maintenance of equipment, and the opinions of the teaching staff who use the equipment will be taken into consideration on how to procure equipment. The following way of procurement of equipment will be considered:

- 1) Equipment that requires regular maintenance such as printers and photocopiers, and equipment that requires daily maintenance and readily available spare parts such as vehicles and tractors will be procured through local sales agents. Local products or the products that are widely used locally will be selected without consideration of the origin.
- 2) Measurement instruments that require special consideration for measurement units, analytical instruments that require special attention to the convenience of operation, and experimental kits that are designed specially for education with well prepared manuals and not produced by Japanese manufacturers will be procured in PNG or in third countries.

2-3-2 Basic Design

(1) Project Site

The Taraka campus of the University is in Lae. Lae is the second largest city in PNG and is located at the head of Huon Gulf in the eastern part of the island of New Guinea. It is an industrial town with many factories and has one of the best port facilities in PNG. The population is about 80,000. Rabaul is situated at the north-eastern tip of the island of New Britain. It was heavily destroyed by eruptions of two volcanoes in 1994. However, the roads, harbour and air port are being restored. Vudal University College is about 40 km upcountry from Rabaul and was not affected by the eruptions except for the fall of a small amount of volcanic ash.

The buildings of the Taraka campus are two-storeyed, the first ones having been built in 1965. The newest building is that of Mining Engineering Department built in 1989. Laboratories of all buildings have enough space to accommodate equipment to be provided by this Project. The buildings of Vudal University College were also built in 1965 and one-storeyed. The laboratories have enough space to accommodate new equipment. As such, there is no problem with the installation of equipment to be provided by this Project.

Figure 2-1 and 2-2 are the maps of the Taraka campus and Vudal University College.

(2) Equipment Plan

Table 2-2 is the list of major equipment to be provided. The list of all items is in Appendix 6. The layout plan of equipment is in Appendix 7.

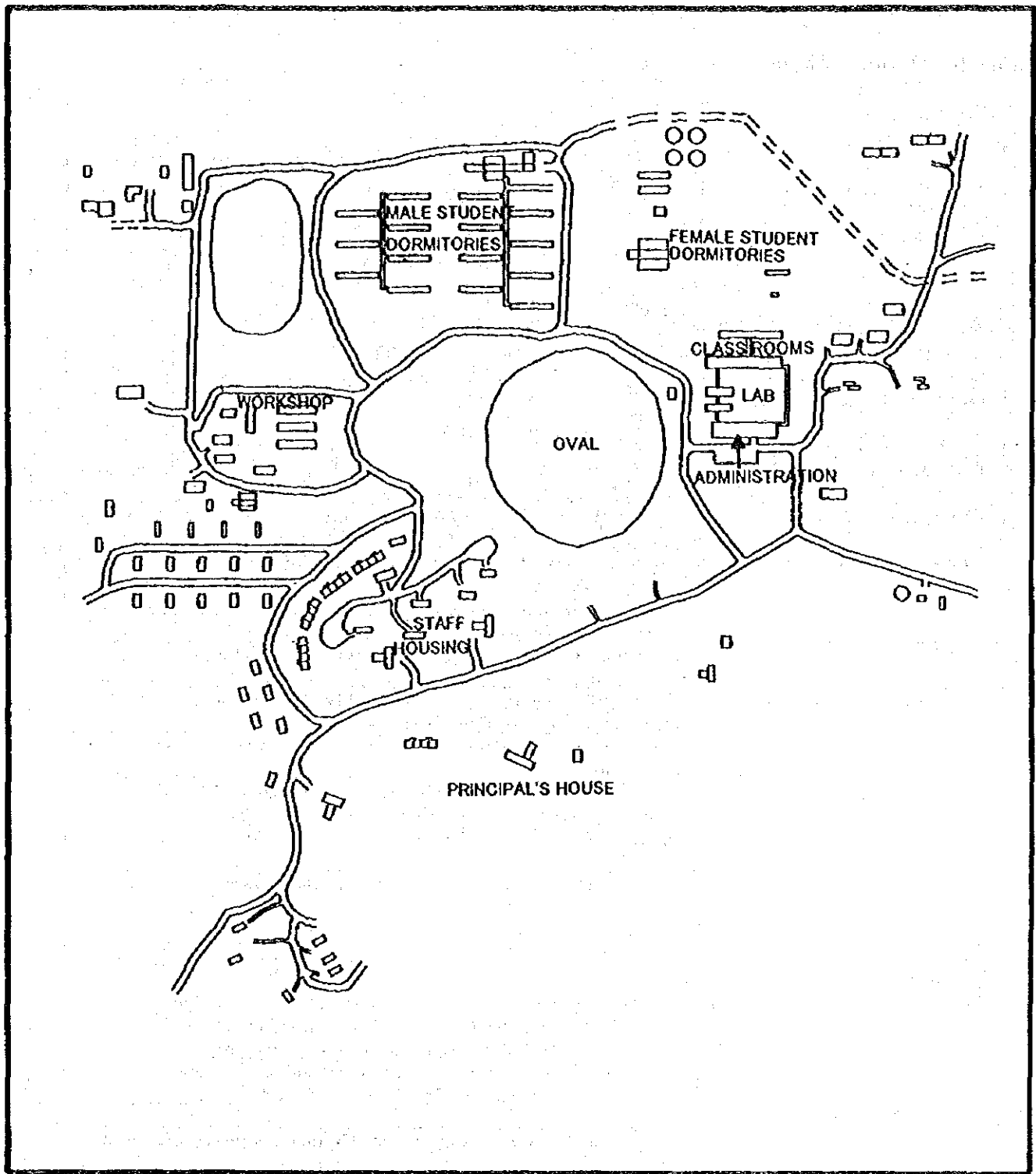


Fig. 2-2 MAP OF VUDAL UNIVERSITY COLLEGE

Table 2-2 Outline of Major Equipment

Name	Short Specification	Qty
A. TARAKA CAMPUS		
Dept. of Civil Engineering		
Software	A set of software to be used in the classes for design and cost	1
Time lapse camera and projector unit	Consisting of a PC, Video Cassette Recorder, Video Monitor etc. Data analysis of speed pattern etc.	1
Data Logger	Used for collection of experimental data of transportation engineering. Input channel : 10 - 40 ch, Measuring range : Max. 500ms/40ch, No. of computation channel : Max. 30ch, Communication module : GP-IB, RS-232C etc.	1
Dept. of Electrical and Communication Engineering		
Digital Signal Processing System	DSP (40MHz/32 bit), with C-compiler etc.	1
Computer System	A system comprising 15 PC's, 3 EWS's, 1 Printer, 2 Color Printer, 1 Pair Modem, 1 pair X 25PAD Trainer etc.	1
Dept. of Mechanical Engineering		
Lathe Machine	Swing over bed : Approx. 360 mm, Distance between centers : Approx. 800 mm, Range of speeds : Max. 1800 rpm	1
FFT Spectrum Analyser	No. of Input channel : 2, A/D converter resolution : 16 bit, Frequency range : 10mHz - 100kHz	1
Universal Testing Machine	Load range : Max. approx. 300kN, Tensile test (max. distance betw. gripping heads) : Approx. 800mm, Compression test (max. distance betw. compression plates : Approx. 720mm), Transverse & cold bend test (max. distance betw. supports : Approx. 500mm)	1
Test Equipment	Comprising an oscilloscope, frequency counter, signal generator, distortion meter etc.	1
Refrigeration Test Bench	Refrigerating capacity : Aprox. 3000kcal/H, Compressor : Air cooled, Motor : approx. 1.5kW, Condenser : Water cooled	1
Gas Turbine	Gas turbine compression ratio : 2:1, Gas turbine RPM : Approx. 30,000 - 84,000 rpm	1
Air-Conditioning Bench	Air supply unit : Variable flow rate fan approx. 6,000m ³ /h, Primary heater : Approx. 2kW, Secondary heater : Approx. 3kW, Compressor/drive motor : Approx. 0.4kW, Outlet : PID control/SCR regulator	1
Heat Transfer Bench	Composition : Water tank, circular pump, storage tank, flow meter, thermometer, Cooled water area : Flow meter approx. 500 lit/h, Thermometer : 0 - 100°C	1
Brinell Hardness Testing Machine	Type : Hydraulic, Max. Loading : 3,000 kgf, Measuring range : 2,500 - 500 kgf	1
Microscope Fitted with a Video Camera	Microscope : Bright field/Dark field, Incident flourescent light : Differential interference/Phase difference with photomicrographic equipment, 3-CCD video camera, 20" monitor, VCR, etc.	1
Electric Dischage Machine	Tank dimensions : Approx. 630 x 400 x 260 mm, Dielectric tank : Approx. 50 lit. Max. weight of work piece : 300 kgf	1
Dept. of Surveying & Land Studies		
GPS	Full wavelength L1 and L2 on carrier, Minimum accuracy of horizontal (Static) : 5mm + 1ppm, Kinematic : 2cm + 1ppm, Real time differential code < 1m	3
Aitomated Surveying Systems Total Station	Dual axis compensator, 2-way communications of data, etc. Angle accuracy : 1", Linearity : 2mm + 3ppm or better	3
Surveying & Mapping System	Comprising 6 PC's, 1 PC Server, 1 A0 Prolter, Mapping Software etc.	1
Dept. of Mining Engineering		
Mining Engineering Computer System	A system comprising 10 PC's, 1 Scanner, 3 EWS's, 1 Printer, Mining Software etc.	1
Universal Testing Machine	Load range : Max. approx. 2000kN, Max. distance betw. comp. plate : approx. 500mm, With 1 Universal Testing Machine (300kN) and 1 Surface Grinder	1
X-ray Diffractometer	X-ray generator : Max. approx. 3kW, Goniometer : 2θ meas. range : -60 ~ +158°C, Goniometer radius : 185 mm, Detector : Counting linearity - 500.000 cps	1

Name	Short Specification	Qty
Particle Size Distribution Analyser	Measuring range : 0.01 μ m - 300 μ m, Sample amount : Less than 10mg, Detector : Silicon photo-diode	1
Microphotometry System	Eyepiece : PLAN widefield eyepiece, Objective lens : Infinite objective lens, Fluorescent filter : UV, V, B, G, Lighting : Halogen lamp	1
Lamps(XRF,XRD,AA)	Spare lamps for XRF : Tungsten, Chromium, for XRD : Co & Fe tube, and for AA : Fe, Cu, Mg, Al	1
Glassware	One lot of flask, erlenmeyer flask, cylinder, beaker, griffin beaker, Kjeldahl flask, Kjeldahl petri dish, test tube, pipette, others	1
Chemicals	Acetone, ammonia water, strontium chloride, potassium chloride, glycerin, toluene, other reagents	1
Process control equipment	Sump tank : approx. 18 lit, Pump : approx. 0.2 - 3.0 lit/min., Flow meter : approx. 0.2 - 3.0 lit/min	1
Magnetic separation	Composition: Feed box, cylinder, stainless steel tank, chain drive, motor Type: Single drum	1
Electrostatic separator	Separation capacity : approx. 330 lbs/h, Particle size : approx. 16 - 200 mesh, Selection range : Variable selection	1
Samples splitters for slurreis + Dry solids	Max. particle size : approx. 0.8", Slurry cutter speed : approx. 29 rpm, Tank dia. & capacity : approx. 16", 2.4 lit.	1
Heavy medium separator	Composition : float discharge launder, sink dis. launder, flexible partitions, chain drive w/gear reduced motor., Drum dia. : approx. 20"	1
Electronic Briquetting press	Pressure method : 4 pole manual hydraulic, Pressure capacity : max. 6 ton, Cylinder stroke : approx. 150mm	1
Dept. of Architecture & Building		
CAD system for Architecture & Building	A system comprising 25PC's, 1PC Server, 1A0 Color Plotter, CAD Software, 3 Staff PC's etc.	1
Dept. of Agricultura		
Vehicle	A vehicle used for transportation of materials and students. Type of Engine : 6 cylinder OHC or Equivalent, Type : 4WD, Piston displacement : approx. 4000cc	1
Fume Hoods with Acid Extractor	Main structure : Steel, melamine enameled, Duct : PVC, Exhaust fan : approx. 0.25m/s, Dimensions : approx. 1500 x 750 x 2300 mm	3
Acid Resistant Cupboard & Extractor	Cartridge capa. : approx. 14 lit., Removal effects : More than 99%, Exhaust volume : approx. 140m ³ /h, Main material : Stainless	5
Compound Research Microscope	Objective lens : Infinite objective lens, Incident illuminator : Bright field / Dark field / Polarizing contrast / Interference contrast / phase	1
TV 20ins. 4system	VCR, PAL/M-NTSC, Horizontal resolution : More than 240 TV line, Input/output : Video and Audio x 1 each, 14" video monitor, PAL/SECAM/NTSC	1
Illuminated Cooled Incubator	Temp. setting range : -10.0 - 50.0°C, Temp. distribution : \pm 0.5°C, Volume : approx. 250 lit.	1
Lighting Accessories for Greenhouse	Ascent/descent type lighting equipment, Spare lighting equipment	3
Growth Chambers	Temp. setting range : approx. 4 - 40.0°C, Temp. accuracy : \pm 0.5°C, Inner dimensions : 0.76 x 2m ²	3
Sheet Metal Guillotine Machine	Cutting thickness : 2.0 mm or more, Cutting length : Approx. 1300 mm	1
Metal Bandsaw	Round cutting capacity : Max. 200 mm, Square cutting capacity : Approx. 250 x 200 mm, Cutting speed : Approx. 27 - 80 mm/min., Motor power : Approx. 2.2 kw	1
Front End Loader	Applicable tractor power : 25 - 34 PS, Lifting capacity : Approx. 2550 - 300 kg, Max. lift height : Approx. 2.3 - 2.4 m, Bucket type : Standard bucket	1
Dept. of Forestry		
Compound Microscope	Eyepiece : 10X, Objective lens : 4X - 100X, 3-CCD video color monitor, 14" Color video monitor	20
Tractor/Slasher	Binder, 2-Row type, Type of engine : Approx. 6.0 PS/2700 rpm, Working W & H : 650 mm /60-120 mm approx., Thresher, Power : Self-propelled 4 cycle Diesel engine, Piston displacement : Approx. 212 cc, Working speeds : Approx. 15 hr/8a	1
Dept. of Mathematics & Computer Science		
Computer system for Education	A system comprising 30 PC's, 1 NT Server, 1 UNIX Server, 1 Printer	1

Name	Short Specification	Qty
Multimedia Computer	A system comprising 1 PC, 1 Scanner, 1 CD-ROM Reader, 1 Projector, Multimedia Software etc.	1
Dept. of Business Studies		
Computer system for Students Education	A system comprising 15 PC's, etc.	1
Computer system for Multi-media Practice	A system comprising 20 PC's, 1 PC Server, 1 Printer, 1Plotter etc.	1
Dept. of Applied Physics		
UV Pulsed Lasers	Wavelength : 360 - 990 nm, Pulse width : 500 ps	2
Comp. Electron Spin Resonance System	A system comprising ESR basic unit, ESR control unit, Helmholtz coil, Multimeter, 2ch oscilloscope etc.	1
PMT Detection System	A system comprising Photon counting PMT housing w/power supply, Analog PMT housing w/power supply, Photon counting/direct output PMT housing w/PS	1
Dept. of Applied Sciences		
Photomicrograph System	Eyepiece : 10X, Objective lens : 4X - 100X, Incident fluorescent filter : UV, V, B, G	1
Polarograph with ASV Capacity	Sweep voltage : 0 - ± 3990 mV, Sweep speed : Max.approx. 2000 mV/sec., Current meas. range : Max.approx. 1000 μ A/V	1
Atomic Absorption Spectrophotometer with Graphite Furnace	Optical system : Double beam, dual blazed grating, reflecting optics w/protective coatings, Bandwidth : 185 - 860 nm, Diffraction grating : approx. 1,800 line/mm, Spectral bandwidth : 0.2, 0.7, 2.0 nm	1
Dept. of Language & Communication		
Computer system for Language Learning	A system comprising 25 PC's, 1 PC Server, 1 Printer, English Learning Software, etc.	1
Computer Services Centre		
Computer system for Common Use (A)	A system for Mechanical Engineering Building's computer lab., comprising 20 PC's, 1 PC Server, 1 Projector, 1Printer	1
Computer system for Common Use (B, C, D)	A system for Sandover, Mathematics and Civil Engineering computer labs, comprising 60 PC's, 3 PC Server, 3 Projectors, 3Printers	1
E-mail & Inter Net Service	A system comprising 1 EWS, 1 Printer, 1 DAT, 1 Switching Hub, Communication Software etc.	1
B. VUDAI, UNIVERSITY COLLEGE		
Fume Cupboard	Dimensions : approx. 1500 x 750 x 2300 mm	1
Incubator	Temp. setting range : approx. -10.0 - 50.0°C, Temp. distribution : $\pm 0.5^\circ\text{C}$, Capacity : approx. 250 lit.	2
Horsepower Tractor	Driving method : Water cooled, 4-cycle diesel, Piston displacement : 1300 cm ³ or more, Max. horse power : Gross 30 HP/ 2800 rpm	1
Video projection and viewing equipment	LCD panel : 1.3", Projection lens : F2.5 - 3.2 f=47 - 75 mm, Screen size : 20 - 400"	1
Automatic Weather Station	Meas. objects : atmospheric pressure, temp., humid., wind direction, wind velocity	1
Bus (25 seaters)	To be used for transportation of students. Type of engine : 4 cy. in-line OHV or Equivalent, Diesel, Driving method : Rear 2 wheel drive	1
Single Cab Utility	Type of engine : 4 cy. in-line OHV or Equivalent, Diesel, Driving method : Rear 2 wheel drive, Piston displacement : 1800 cc or more	1
Fixed thicknesser	Max. width of cut : Approx. 400 mm, Max. thickness of cut : Approx. 300 mm, Min. length of cut : 240 mm or more	1
Fixed radial arm saw	Max. diameter of circular saw : $\phi 350$ mm approx., Max. depth of cut : 110 mm or more, Table width x length : Approx. 860 x 3000 mm	1
Fixed Planer	Shape of spindle : Cylinder with 4 knives, Spindle speed : Approx. 5000 rpm, Table length : 2000 mm or more	1
Fixed jig saw	Max. Cutting Height : 300 mm or more, Blade dimensions : Approx. 70 x 2800 x 0.65 mm, Dia. of saw wheel : Approx. 410 mm	1