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UNIDO CONTRACT NR. 88/51/RK

17403

MANUFACTURING SYSTEMS ENGINEERING PROGRAMME

at the

ASIAN INSTITUTE OF TECHNOLOGY

AIT

Bangkok - Thailand

FINAL REPORT

Enerconsult Srl - Brescia (Italy)

UNITED NATIONS INDUSTRIAL DEVELOPMENT ORGANISATION

Project Proposal

PART A - BASIC DATA

Country/Region : Regional Asia

Project Number : US/RAS/88/51

Project Title : Strengthening the Capabilities of the Asian Institute of Technology (AIT) (1) in Education/Training, Research in the Field of Manufacturing Systems Engineering

Scheduled start : January 1989

Scheduled completion : December 1992

Origin & date of official request : Request made by the President of AIT, Prof. A. M. North to the Director General of UNIDO, Mr. D.L. Siazon Jr. in Bangkok, November 1987.

Government counterpart agency : Asian Institute of Technology (AIT)

UNIDO contribution : US \$ 5.375 million (excluding 13% overcharge)

Government/AIT contribution : in kind

Currency required for UNIDO input :

convertible : US \$ 5.375 million

other : -----

UNIDO substantive backstopping : Industrial Training Branch
branch/section

UNIDO co-operating branch/section :

Programme component code : J 14201

(1) The Asian Institute of Technology (AIT) is an autonomous international post-graduate technological institution. Originally established in 1959, the Institute was chartered in 1967 as an independent, international and non-profit making educational institution by special legislation of the Royal Thai Government. It is located in BANGKOK (Thailand).

PART B - NARRATIVE

I. Objective

a. Development Objective

The key to economic prosperity for the developing countries of the Asian region lies in a balanced growth of agriculture and industry. The economies of these countries cannot continue to be predominantly agrarian if they are to accelerate economic growth. The development of the industrial sector is vital to economic development, and the key to industrial growth and economic competitiveness lies in becoming better producers.

Industries in the region are faced with the evolving complexities of integrating human resources, materials and machines. The availability of computers nowadays, however, is an immense help in integrating the various resources at the industries' disposal. To become competitive, industries must aspire for good industrial engineering practices that lead to producing goods/services at the least cost, highest quality, and shortest delivery time.

One of the primary objectives of AIT is to help serve the technological requirements for the industrial development of the region. To this end, the project is aimed at strengthening the manufacturing systems engineering capabilities of AIT to respond to the industrial needs of the region. This form of linkage is needed to improve the match between the needs of the industrial sector of the developing economies of the region and the skills produced at AIT.

b. Immediate objectives

- i) To strengthen AIT's educational/training/research capabilities in Industrial Engineering through the introduction of a Manufacturing Systems Engineering programme to meet the manufacturing needs of the region.
- ii) To provide advanced education to engineers in the region (long-term master's degree) involved in manufacturing activities in industry, academic institutions, research and development institutions, and government agencies.
- iii) To upgrade skills of AIT trainers/lecturers and industrial personnel on manufacturing systems.
- iv) To provide consultancy services in manufacturing systems to industries of the region.
- v) To establish/strengthen AIT's industrial information capabilities in manufacturing innovative technologies through an Industrial Data Base Information Service.

- vi) To assess the manpower and training needs of the programme with a view to upgrading the skills of different identified target groups either at institutional or at plant levels.

II Special considerations

This project is expected to be financed through voluntary contribution by the Government of Italy to the Industrial Development Fund (UNIDO). This is also a follow-up to the meeting between the President of AIT, Prof. A.M. North, and Mr. Manfredo Incisa di Camerana, Minister Plenipotentiary of the Multilateral Co-operation Bureau of the Government of Italy on the occasion of the Second General Conference of UNIDO in Bangkok, Thailand, November 1987.

III Background and Justification

1. Introduction

Since 1976, UNIDO has implemented many training programmes to promote and accelerate the industrialization of developing countries. In 1975, at the Second General Conference of UNIDO in Lima, Peru, the Declaration and Plan of Action on Industrial Development and Co-operation stated that every effort must be made to increase the share of world industrial production in developing countries to 25% by the year 2000. The actual percentages were only 10.08% in 1963, 8.6% in 1975 and 10.66% in 1983.

The current level of industrialization of the developing countries in the region is very low. On the average, the per capita output of manufacturing workers in these countries is less than 11% of those of the industrialized countries. From 1965 to 1983 the overall per capita output of industrial workers in the developing countries of the region increased from \$341 to \$756, i.e. by \$415. This compares with an increase from \$3,831 to \$15,514, i.e. by \$11,683, for similar workers in the industrialized countries. Thus the improvement in productivity of the workers in the industrialized countries was a massive 28 times that of the workers in Asia's developing countries. Even the small growth of industrial productivity in the developing countries can be attributed largely to the opening up of multinational industrial ventures. Furthermore, the GDP share from manufacturing industries in developing countries is very small compared to that in developed countries.

The methods used for industrial development and technology transfer by world organizations include establishing technical education and training institutions, the training of personnel in foreign countries, setting up industrial ventures through aid and loan schemes and forming local development organizations under the patronage and advice of foreign countries. World Bank reports indicate, however, that these actions have had very little impact on industrial growth in the developing countries. Indeed, in some cases the effect has been negative. The mass exodus of trained personnel from the developing countries is one example. Incidentally, AIT is a happy exception - 93% of its alumni continue to work in Asia.

The very low industrial output and productivity in developing countries are mainly due to low investment in manufacturing industries, failure to use modern manufacturing methods, and weak industrial management.

Most factories in developing countries still use equipment and methods of work which were well established decades earlier. The manufacture of components and the assembly of products is overwhelmingly governed by the skills and judgement of the available workers. As a result the products are uncompetitive in price and low in quality. Furthermore, parts are not interchangeable. In some cases prices have been kept low by using inferior material. This has resulted in the rejection of these products by the consumers even in the local market, especially under open market policies. This often leads to the eventual closure of factories.

The managements of industries in developing countries are themselves by no means blameless for low productivity. They rarely use modern management techniques and management support systems. This is not surprising since many of them have received no training in management.

2. Evolution of the Industrial Engineering Discipline

Originally, industrial engineers were primarily concerned about designing the tools, work place, and other aids in order to make the person more productive. The original principles were built upon the so-called "one best way" to perform a micro task. These principles draw heavily upon the work of non-engineers especially the behavioral scientists in their study of the human being as an element of a productive system.

The traditional industrial engineering curricula in many universities in the world require the basic operations research, economics, management, physical sciences, engineering sciences, and some design experience. Whereas traditional engineering students (mechanical, electrical, chemical, etc.) go on to develop highly specialized knowledge in the applications of basic engineering subjects, industrial engineering students spend more time in so many different areas, i.e. the IE curriculum tends to be quite broad with more emphasis on the techniques and methods of the profession and less emphasis on practice.

3. Computer Integrated Manufacturing Systems (CIMS)

Computer technologies are having a profound impact on the current economic condition and future industrial improvement of the developing countries. The advent of the cheap micro-processor is augmenting and accelerating the process of change and its social and economic consequences.

Computer technologies can markedly increase the productivity of men and machines as well as enhance the effectiveness of economic planning and investment decision making. But the potentials and limitations of expert systems, computer aided manufacture, computer assisted management systems and large scale data base systems must be thoroughly understood. The effect of computers on the number and the nature of the jobs must be managed to achieve the greatest benefit not only for the economy but also for the individuals affected by the change process.

The process of acquisition and use of computer-based systems presents a significant management problem. Knowledge is essential regarding how hardware and software selection and modification should be administered; of how staff orientation and training should be conducted; and how system growth, operational utility, and costs should be controlled.

4. Future Impacts for Industrial Engineers in Manufacturing Systems

The opportunities for industrial engineers with responsibility in manufacturing are accelerating, and the projects are becoming far more complex than ever before. This means that more industrial engineers will be finding opportunities to serve in a project engineering role; and the skills and tools required to practice in this environment will also be more sophisticated.

5. Factory Automation and the Industrial Engineer

The impact of factory automation, computer integrated manufacturing and the like has been well documented regarding improved productivity, increasing a company's competitive edge and other similar benefits. Very little mention has so far been made at the impact on the practice of industrial engineering. Of course, the opportunities in manufacturing are being created by the tremendous emphasis being placed on factory automation and Computer Integrated Manufacturing Systems. Industrial engineers who recognize this and who prepare themselves accordingly are the ones who will be able to step up and take a leadership role in the planning, design and implementation of such projects.

However, the domain of computer applications in manufacturing is continually evolving. Computerization is not only used off-line to support manufacturing operations, but also it has entered into a new area of computer integrated manufacturing. With CIMS, one can cater to broad variety, small volume production needs with a better cost structure than a traditional mass-scale production system.

Shorter lead time, lower levels of work in process, quick response to market change, better production control are benefits made possible with effective use of CIMS.

It has sometimes been argued that in mass production industries the flexibility offered by computer controlled machine tools is unnecessary.

There may be some substance to this argument if it is applied solely to the production line, but a CIMS facility enables a manufacturer to design and develop prototypes, tools and dies with enormous saving in lead time.

6. Institutional Framework

The entire project will be implemented within the framework of the Asian Institute of Technology in Bangkok (Thailand).

6.1 AIT in General

The Asian Institute of Technology is an autonomous, post-graduate technological institution. It is recognized that the Asian Institute of Technology has obtained a unique position in South-East Asia by providing postgraduate education, continuing education and training programs open to candidates from all nations in the region. The detailed description of the Institute is given in Annex 8.

The academic program at AIT, therefore, are clearly related to the development needs of Asia. They include the study of problems common to the region as well as study of the engineering and scientific methods upon which the solution to these problems depend.

As is the case in other AIT activities, AIT will also open the new facility to nationals of other developing countries from outside the region. So far, students of AIT have been drawn from countries across the Asia and Pacific region, including some African nations, such as Botswana, Ghana, Nigeria, Tanzania and Malawi. These developing countries benefit directly from the problem oriented teaching and research programs of the Institute. So far, approximately 93% of the graduates who have been trained at AIT in the past 29 years continue to work in Asia.

AIT maintains a high standard of education and research programs and encourages its students to conduct research relevant to the development needs of their countries. Since AIT's main objective is to provide postgraduate technological education to students from the countries of the region, the Institute continuously evaluates and updates its programs to ensure their appropriateness to the needs of the region.

Moreover, the Institute provides an open and free environment for Asian students to work and live. The host country Thailand can demonstrate a high degree of development; and provide students from less developed countries with a more realistic example than the highly developed nations. The Institute is furthermore dependent on funding from the member nations. This ensures the relevance of the Institute activities to member needs.

6.2 The present status of Industrial Engineering at AIT

Industrial Engineering education at AIT is based in the Institute's Division of Industrial Engineering and Management. The Division offers programs which prepare students for management and decision support

positions in industry and in the public sector. These programs are designed to equip the students with a broad range of decision making skills for use in a variety of applications. The emphasis is on developing analytical skills and technical competence so that graduates are both well trained technically and adaptable in dealing with unpredictable management decisions in the future.

Students are required to undertake independent research under the supervision of one of the faculty members. This part of the program allows students to develop confidence in using the tools they have acquired for addressing real world problems. To enable students to better appreciate real world problems, regular visits to private and public organizations also form a part of the training program.

A detailed description of the Division programmes and activities are given in Annexe 9.

6.3 New Manufacturing Systems Engineering Program at AIT

The new program will blend and complement with the existing programs at AIT in general. In particular, it will complement AIT's programs currently offered in the Division of Industrial Engineering and Management, Division of Computer Science, Regional Computer Center, and partly with the Division of Energy Technology. Detailed descriptions of the said existing programs are given in Annex 6.

IV Project Outputs

Output 1

- A. - Capacities and capabilities of AIT strengthened in Manufacturing Systems Engineering through the establishment of master's degree curriculum in 3 areas (general engineering, engineering control, planning) and through the creation of a new laboratory facility (advanced education/training/research robot tools/fully automatic 3-dimensional coordinate measuring machine).
- B. - A total of 60 engineers (at rate of 20 per year) trained with a master's degree in MSE.

Output 2

- A. - 12 staff of AIT trained as trainers in MSE.
- B. - A total of 120 engineers/managers from industry, academic institutions, research and development institutions and Government agencies from the countries in the region also trained and skilled in specific areas of MSE (Maintenance, CAD, CAM, CIMS, FMS, CAI, Artificial Intelligence, Factory Automation, Warehousing, etc.).
- C. - A total of 240 engineers/managers/industrial planners from industry, academic institutions, research and development institutions and Government agencies from the countries in the region fully acquainted with the impact of advanced technologies in MSE and with the incidence of their operations and competitiveness.

Output 3

- A. - AIT consultancy unit/services strengthened and able to conduct/provide consultancy services to the existing industries in the area of Manufacturing Systems Engineering.
- B. - Industrial data base established with necessary technical services.
- C. - A detailed report on manpower and training assessment survey setting out, inter alia, priority training needs of the industrial sectors of the AIT member countries, different target groups concerned and including specific training proposals in MSE with their main parameters and curricula.

Output 4

1. - Annual progress report of the project activities.
2. - A detailed joint in-depth evaluation report.
3. - Final report setting forth conclusions and concrete recommendations for further action which might be taken.

V PROJECT ACTIVITIES AND MODALITIES OF IMPLEMENTATION

The project will extend over a period of 4 years, during which a project coordinator under split missions will be recruited. His draft job description is attached in Annex 1.

In addition, long-term and short-term consultants will be also recruited to design and conduct specific training courses in MSE and to perform specific duties as indicated above. Their specific job descriptions are also attached in Annex 2/a, 2/b, 2/c, 2/d.

Given their specificity, some project activities will be executed under subcontractual services to a qualified and experienced firm in MSE. Draft terms of reference are attached in Annex 3.

(a) Activities Related to Output 1

- Designing and developing a Master's degree curriculum in Manufacturing Systems Engineering.
- Providing AIT with a Manufacturing Systems Engineering laboratory with the necessary machinery, hardware, software, interfaces, systems software, as well as education/training/research tools to enable AIT to conduct educational/training/research programs.
- Providing advanced education for a Master's degree to postgraduate students of AIT over a period of 20 months. The program will, inter alia, include fellowships and study tours. It will be organized for groups of 20 each for 3 groups over the duration of the project. The third group may be only partially covered by the project, with AIT continuing it.

(b) Activities Related to Output 2

- Preparing and conducting training programs for AIT trainers and staff in the use of laboratory equipment and specific software. This will include study tours to developed countries prior and during the equipment installations.
- Preparing and conducting training programs for the 120 engineers/managers mentioned under outputs 2-B and the 240 senior engineers/managers/industrial planners mentioned under outputs 2-C, in the

efficient use of equipment and applications of computerized programs to industries of the region by means of short courses, seminars, workshops, and panel discussions on Manufacturing Systems Engineering in selected countries of the region.

(c) Activities Related to Output 3

- Identifying and analyzing, through consultancy, the problems faced by industries in manufacturing and providing ways and means of action and making concrete recommendations for actual implementation.
- Carrying out research activities related to the manufacturing needs of the region.
- Assessing the existing information services at AIT and provide additional hardware and software support as well as documentations and acquisition of technical reviews, books, manuals on manufacturing systems (CAD / CAM, etc.)
- Preparing and conducting a survey mission in selected countries of the region to identify the target groups and their respective profile for skills development, to formulate specific proposals, to make concrete recommendations for further action, and to submit a detailed report on findings and conclusions.

(d) Activities Related to Output 4

(To be completed by the Project Manager)

1. Preparing and submitting annual progress report outlining inter-alia the result of activity carried-out.
2. Drafting the terms of reference of the joint in depth evaluation and determining appropriate dates and conducting the evaluation session with all concerned.
Preparing and submitting a detailed evaluation report including recommendation for further action.
3. By the completion of the project formulating conclusions, recommendation and specific proposal for possible follow-up action required and preparing and submitting the final report of the project.

The tentative workplan of the project is attached in Annex 4.

VI PROJECT INPUTS

a) AIT Inputs

1. Project Director/senior faculty member with experience in overall management of projects, general administration, and Manufacturing Systems Engineering. The Project Director will be responsible for the general administration and liaison with the Chief Technical Adviser.
2. Senior Laboratory Supervisor with experience in a wide variety of hardware, hardware interfacing problems, and computer operations. He will be responsible for the daily operations of the laboratory and industrial application programs.
3. Two supporting non-technical staff, i.e. secretaries, software librarian (full-time).

In addition, AIT will provide necessary facilities such as:

- furniture
- telex - telefax
- office space
- local transportation of the project staff
- space and use of laboratories in I&EM, CS, Energy, AFE Divisions
- use of CAD Systems

b) UNIDO INPUTS

1. Chief Technical Adviser
27 m/m preferably from a professional consulting company with experience in international project management and Computer Integrated Manufacturing System.
2. 108 m/m. Three international experts in Manufacturing Systems Eng., factory automation, manufacturing systems as full time faculty.
3. 122 m/m International experts in Computer Integrated Manuf. and Computerized Controls with experience in:
 - Manufacturing System
 - Artificial Intelligence
 - Quality Control
 - Control of Manufacturing Processes
 - CAD/CAM in Engineeringfor short courses, seminars, in-service training, preparation project, consultancy.
4. 60 m/m study tours in Italy for 60 students.

(Selection of all personnel secondments, long-term and short-term experts, to AIT by UNIDO will be subject to approval of the Institute).

5. Training Provisions

75 m/m in-service training for upgrading personnel in Manufacturing Systems in industries of the region.

6. Fellowships (1)

a. 20 m/m fellowship at AIT for 60 students: 20 students per annum for 3 groups over the four-year program.

b. 60 m/m study tour in Italy for 60 students (if B.L.=32).

7. Training equipment

- for a total of US\$ 1,380,000.

Tentative list including type and approximate prices of each item is attached in Annex 5.

VII EVALUATIONS PLANS

In accordance with the wishes of the donor government and in conformance with United Nations practices, a special in-depth evaluation of this project will be carried out during the life of the project. Specifically, an in-depth evaluation is expected at mid-project/end of phase 1/after two years.

VIII ENVISAGED FOLLOW-UP

It is expected that, following the strengthening of the education/training/research functions of the selected institution, UNIDO will encourage the organization of similar programmes at local and subregional levels, promoting TCDC arrangements among the institutions. Besides, it is expected to apply this concept to other education/training/research institutions in the region.

(1) The M. Eng. degree normally requires five terms or 20 months of study. The master's degree scholarship is valued at US\$ 19,000 for 1990, US\$ 20,000 for 1991, US\$ 21,000 for 1992; which provides function and fees, bursary and accomodation, textbook grant and travel grant from the student's home country.

PART C - CLEARANCE AND APPROVAL

Proposal submitted by: _____ Date: _____

Proposal cleared by : _____ Date: _____

_____ Date: _____

_____ Date: _____

_____ Date: _____

Proposal approved by: _____ Date: _____

CURRENCY REQUIRED :

 CONVERTIBLE :

 OTHER :

SOURCE OF FUNDS :

DATE PAD REQUESTED:

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ANNEX 1
Chief Technical Adviser

JOB DESCRIPTION

- Post title** : Chief Technical Adviser (CTA)
- Duration** : Twenty-seven months in split missions, over the four-year project.
- Date required** : January 1989
- Duty station** : Bangkok, Thailand and Italy.
- Purpose of Project**: To strengthen the educational/training/research capabilities of the Asian Institute of Technology (AIT) in the field of Manufacturing Systems Engineering.
- Duties** : 1) In consultation and collaboration with the appropriate officials of AIT and UNIDO, the CTA will be responsible for the management of the project including, among others, the following tasks:
- Development of subsequent adjustments, if necessary, to the necessary workplan;
 - identification of long-term and short-term experts /consultants;
 - local administration and follow-up of the fellowship and study tour activities;
 - ordering and installation of the equipment purchased under the project;
 - supervise the development and conducting of the programmes, as appropriate;
 - writing progress and final reports every year-end and at the completion of the project.
- 2) In consultation and collaboration with the appropriate officials of AIT and UNIDO, the CTA will also provide consultation and training services as required by the project. This task will include the following activities:
- Participating in the short-term courses and conducting the survey mission;
 - providing advice to the local AIT technical staff and international experts/consultants on their respective duties.

(annex 1 - page 2)

Qualifications : The expert should have a doctoral degree in engineering with extensive experience in Computer Integrated Manufacturing Systems and project management at the international/regional level.

Language : English.

Background Inform.: The Asian Institute of Technology is an autonomous, post-graduate technological institution. The primary objective of the Institute is to serve the technological development of Asia by providing advanced education and engineering, science and related fields.

The academic programs at AIT, therefore, are clearly related to the development needs of Asia. They include the study of problems common to the region as well as study of the engineering and scientific methods upon which the solution to these problems depends. Students, so far, are from countries across the Asia and Pacific region including some African countries such as Botswana, Ghana, Nigeria, Tanzania and Malawi. These developing countries benefit directly from the problem oriented teaching and research programs of the Institute. So far, approximately 93% of the over 4,000 graduates who have been trained at AIT in the past 28 years continue in the region.

AIT maintains a high standard of education and research programs and encourages its students to conduct research relevant to the development needs of their countries. Since AIT's main objective is to provide post-graduate technological education to students from the countries of the region, the Institute continuously evaluates and updates its programs to ensure their appropriateness to the needs of the region.

ANNEX 2/a
Full-time Experts 1

JOB DESCRIPTION

- Post title** : Expert on Modeling and Design of Manufacturing Systems
- Duration** : One year, with possibility of extension
- Date required** : January 1990
- Duty station** : Bangkok, Thailand
- Purpose of Project:** To strengthen the educational/training/research capabilities of the Asian Institute of Technology (AIT) in the field of Manufacturing Systems Engineering.
- Duties** : The expert will serve as a full-time member of the teaching and research faculty of the AIT. He is expected to perform the following tasks:
- Teaching advanced post-graduate courses at the master's degree level;
 - conducting research and consultancy activities directed towards manufacturing problems in the region;
 - conducting special programs comprising conferences, workshops, seminars, and other short in-service training courses.
- Qualifications** : The expert should have a doctoral degree in industrial/mechanical/manufacturing/production engineering with strong background in systems science. Preferably he should have industrial experience or industrial consultancy experience. He should be competent in teaching and carrying out research at the post-graduate level in the areas of modeling and design of flexible manufacturing systems, cellular manufacturing systems, and group technology, modeling and simulation.
- Language** : English.

Background Inform.: The Asian Institute of Technology is an autonomous, post-graduate technological institution. The primary objective of the Institute is to serve the technological development of Asia by providing advanced education and engineering, science and related fields.

The academic programs at AIT, therefore, are clearly related to the development needs of Asia. They include the study of problems common to the region as well as study of the engineering and scientific methods upon which the solution to these problems depends. Students, so far, are drawn from countries across the Asia and Pacific region including some African countries such as Botswana, Ghana, Nigeria, Tanzania and Malawi. These developing countries benefit directly from the problem oriented teaching and research programs of the Institute. So far, approximately 93% of the over 4,000 graduates who have been trained at AIT in the past 28 years continue to work in the region.

AIT maintains a high standard of education and research programs and encourages its students to conduct research relevant to the development needs of their countries. Since AIT's main objective is to provide post-graduate technological education to students from the countries of the region, the Institute continuously evaluates and updates its programs to ensure their appropriateness to the needs of the region.

ANNEX 2/b
Full-time Expert 2

JOB DESCRIPTION

- Post title** : Expert on Computerized Control of Manufacturing Systems Operations
- Duration** : One year, with possibility of extension
- Date required** : January 1990
- Duty station** : Bangkok, Thailand
- Purpose of Project:** To strengthen the educational/training/research capabilities of the Asian Institute of Technology (AIT) in the field of Manufacturing Systems Engineering.
- Duties** : The expert will serve as a full-time member of the teaching and research faculty of the AIT. He is expected to perform the following tasks:
- Teaching advanced post-graduate courses at the master's degree level;
 - conducting research and consultancy activities directed towards manufacturing problems in the region;
 - conducting special programs comprising conferences, workshops, seminars, and other short in-service training courses.
- Qualifications** : The expert should have a doctoral degree in industrial/mechanical/manufacturing/production engineering with strong background in systems science. Preferably he should have industrial experience or industrial consultancy experience. He should be competent in teaching and carrying out research at the post-graduate level in the areas of theories and industrial applications of artificial intelligence, microprocessor applications in control of industrial processes, manufacturing automation and control, and industrial electronics.
- Language** : English.

(annex 2/b - page 2)

Background Inform.: The Asian Institute of Technology is an autonomous, post-graduate technological institution. The primary objective of the Institute is to serve the technological development of Asia by providing advanced education and engineering, science and related fields.

The academic programs at AIT, therefore, are clearly related to the development needs of Asia. They include the study of problems common to the region as well as study of the engineering and scientific methods upon which the solution to these problems depends. Students, so far, are drawn from countries across the Asia and Pacific region including some African countries such as Botswana, Ghana, Nigeria, Tanzania and Malawi. These developing countries benefit directly from the problem oriented teaching and research programs of the Institute. So far, approximately 93% of the over 4,000 graduates who have been trained at AIT in the past 28 years continue to work in the region.

AIT maintains a high standard of education and research programs and encourages its students to conduct research relevant to the development needs of their countries. Since AIT's main objective is to provide post-graduate technological education to students from the countries of the region, the Institute continuously evaluates and updates its programs to ensure their appropriateness to the needs of the region.

ANNEX 2/c
Full-time Expert 3

JOB DESCRIPTION

- Post title** : Expert on Manufacturing Systems Planning and Control
- Duration** : One year, with possibility of extension
- Date required** : January 1990
- Duty station** : Bangkok, Thailand
- Purpose of Project**: To strengthen the educational/training/research capabilities of the Asian Institute of Technology (AIT) in the field of Manufacturing Systems Engineering.
- Duties** : The expert will serve as a full-time member of the teaching and research faculty of the AIT. He is expected to perform the following tasks:
- Teaching advanced post-graduate courses at the master's degree level;
 - conducting research and consultancy activities directed towards manufacturing problems in the region;
 - conducting special programs comprising conferences, workshops, seminars, and other short in-service training courses.
- Qualifications** : The expert should have a doctoral degree in industrial /mechanical/manufacturing/production engineering with strong background in systems science. Preferably he should have industrial experience or industrial consultancy experience. He should be competent in teaching and carrying out research at the post-graduate level in the areas of computer applications in factory automation, production, warehousing, materials handling, distribution, and in business management.
- Language** : English.

Background Inform.: The Asian Institute of Technology is an autonomous, post-graduate technological institution. The primary objective of the Institute is to serve the technological development of Asia by providing advanced education and engineering, science and related fields.

The academic programs at AIT, therefore, are clearly related to the development needs of Asia. They include the study of problems common to the region as well as study of the engineering and scientific methods upon which the solution to these problems depends. Students, so far, are drawn from countries across the Asia and Pacific region including some African countries such as Botswana, Ghana, Nigeria, Tanzania and Malawi. These developing countries benefit directly from the problem oriented teaching and research programs of the Institute. So far, approximately 93% of the over 4,000 graduates who have been trained at AIT in the past 28 years continue to work in the region.

AIT maintains a high standard of education and research programs and encourages its students to conduct research relevant to the development needs of their countries. Since AIT's main objective is to provide post-graduate technological education to students from the countries of the region, the Institute continuously evaluates and updates its programs to ensure their appropriateness to the needs of the region.

ANNEX 2/d
Short-time Experts

JOB DESCRIPTION

- Post title** : Experts on Manufacturing Systems, CAD/CAM/CIM/CAE/AI.
- Duration** : One month, with possibility of extension
- Date required** : March 1989
- Duty station** : Bangkok, Thailand
- Purpose of Project:** To strengthen the educational/training/research capabilities of the Asian Institute of Technology (AIT) in the field of Manufacturing Systems Engineering.
- Duties** : The experts will serve as short-time members of the teaching and research faculty of the AIT. They are expected to perform the following tasks:
- Preparing and conducting training programs for the AIT trainers/engineers/managers from industry, academic institutions, and government agencies through short courses, programs comprising conferences, workshops, seminars, and other short in-service training courses.
 - conducting research and consultancy activities directed towards manufacturing problems in the region;
- Qualifications** : The experts should come from industrial/research/management activities in mechanical/manufacturing/production engineering with strong background in systems science.
Preferably they should have industrial experience or industrial consultancy experience. They should be competent in teaching and carrying out research at the post-graduate level in the areas of computer applications in factory automation, production, warehousing, materials handling, distribution, and in business management.
- Language** : English.

Background Inform.: The Asian Institute of Technology is an autonomous, post-graduate technological institution. The primary objective of the Institute is to serve the technological development of Asia by providing advanced education and engineering, science and related fields.

The academic programs at AIT, therefore, are clearly related to the development needs of Asia. They include the study of problems common to the region as well as study of the engineering and scientific methods upon which the solution to these problems depends. Students, so far, are drawn from countries across the Asia and Pacific region including some African countries such as Botswana, Ghana, Nigeria, Tanzania and Malawi. These developing countries benefit directly from the problem oriented teaching and research programs of the Institute. So far, approximately 93% of the over 4,000 graduates who have been trained at AIT in the past 28 years continue to work in the region.

AIT maintains a high standard of education and research programs and encourages its students to conduct research relevant to the development needs of their countries. Since AIT's main objective is to provide post-graduate technological education to students from the countries of the region, the Institute continuously evaluates and updates its programs to ensure their appropriateness to the needs of the region.

ANNEX 3
Terms of reference for sub-contracting

UNIDO Project.....

1. General Information

2. The Aim of the Project

3. The scope of the Contracting Services

4. Generalal Time Schedule

5. Reports

ANNEX 4/a

Tentative Work Plan of the Project

1	Approval of the project	December 1988
2	Selection and fielding of C.T.A.	Jan. - March 1989
3	Recruit.and field.of 3 sh/tera specialists and conduct of the 1st 2 short-time courses and 1st 2 seminars for 1989 (under split missions)	April - May 1989 Oct. - Nov. 1989
4	Survey mission in the region by C.T.A. & AIT dir.	April - May 1989
5	Finalization of the project Work Plan	June - July 1989
6	Specifications of Hardware and Software for the laboratory equipment, by the C.T.A.	June - July 1989
7	Procurement of equipment	Sept. - Oct. 1989
8	Procurement of Software	Sept. - Nov. 1989
9	Selection of long-term experts	November 1989
10	Fielding of long-term experts	January 1990
11	Preparation and development of the different curricula, including evaluation	Dec.'89 - Jan. '90
12	Laboratory preparation and start-up	Nov.'89 - April'90
13	Training of laboratory staff	Nov.'89 - April'90
14	Establish.(prep./start-up) of ind. info-service	Oct. - Nov. 1989
15	First Project Progress Report by C.T.A.	December 1989
16	First in-service training (one month)	March 1990
17	Preparation, development and conduct of the first long-term course for 20 months	May '90 - Dec. '91
18	Preparation and conduct of 2 short-term courses and four (4) industrial seminars by short-time consultants	Jan. - March 1990 Oct. - Nov. 1990
19	2nd Project progress report by the C.T.A.	December 1990
20	Developing of consultancy programme	June'89 - Dec. '92
21	Second in-service training (one month)	March 1991
22	Preparation and development of the 2nd long-term courses for 20 months	May '91 - Dec. '92
23	Preparation and conduct of 2 short-term courses and four (4) seminars in 1991	Jan. - March '91 Oct. - Nov. '91
24	3rd Project progress report by C.T.A.	December 1991
25	Third in-service training (1 month)	March 1992
26	Preparation and development of the 3rd long-term courses by the completion of 1992 (end of project)	May - Dec. 1992
27	Preparation and conduct of 2 short-term courses and 2 seminars for 1992	Febr.- March 1992 Oct. - Nov. 1992
28	Preparation of terminal report and submission	December 1992

Manufacturing Systems Engineering Programme at A.I.T. Bangkok
Overall Programme Activities Timetable - 1989/1992

-----1989-----1990-----1991-----1992-----
j f m a m j j a s o n d j f m a m j j a s o n d j f m a m j j a s o n d j f m a m j j a s o n d

1. Approval of Project (December 1989)

2. Selec. & Field. of CTA
XXXXXXXXXX

3. Short-term specialists

1st short-course XXXXXXX

2nd short-course XXXXXXX

4. Survey mission XXXXXXX

5. Final. Project Workplan XXXXXXX

6. Specif. Hardw. & Softw. XXXXXXX

7. Procurement of equipm. XXXXXXX

8. Procurem. of Software XXXXXXXXXXXX

9. Selec. long-term exp. XXX

10. Fielding long-term exp. XXX

11. Prepar. differ. curricul. XXXXXXX

12. Labor. prep. & start-up XXXXXXXXXXXXXXXXXXXXXXXX

13. Training laborat. staff XXXXXXXXXXXXXXXXXXXXXXXX

14. Establ. ind. info-serv. XXXXXXX

15. First project prog. rep. XXX

16. First in-service train. XXX

17. First long-term course XXX

18. Short-term courses

3rd short-term course XXXXXXXXXXX

4th short-term course XXXXXXX

19. 2nd project prog. rep. XXX

20. Develop. consult. progr. XXX

21. 2nd in-service train. XXX

22. Prep. 2nd long-term c. XXX

23. Short-term courses

5th short-term course XXXXXXXXXXX

6th short-term course XXXXXXX

24. 3rd project prog. rep. XXX

25. 3rd in-service train. XXX

26. Preparat. 3r long-term XXX

27. Prepar 2 short-term c. XXXXXXX

7th short-term course XXXXXXX

8th short-term course XXXXXXX

28. Prep. terminal report XXX

Manufacturing Systems Engineering Programme at A.I.T. Bangkok
 Programme Activities Timetable - 1 9 9 0

-----1989-----
 j f n a n j j a s o n d

1. Approval of Project (December 1989)			
2. Selec. & Field. of CTA	XXXXXXXXXXXXXXXXXXXX		
3. Short-term specialists			
1st short-course	XXXXXXXXXXXX		
2nd short-course			XXXXXXXXXXXX
4. Survey mission	XXXXXXXXXXXX		
5. Final Project Workplan		XXXXXXXXXXXX	
6. Specif. Hardw. & Softw.		XXXXXXXXXXXX	
7. Procurement of equipm.			XXXXXXXXXXXX
8. Procurem. of Software			XXXXXXXXXXXXXXXXXXXX
9. Selec. long-term exp.			XXXXXX
10. Fielding long-term exp			
11. Prepar. differ. curricula			XXXXXX
12. Labor. prep. & start-up			XXXXXXXXXXXX
13. Training laborat. staff			XXXXXXXXXXXX
14. Establ. ind. info-serv.			XXXXXXXXXXXX
15. First project prog. rep.			XXXXXX
16. First in-service train			
17. First long-term course			
18. Short-term courses			
3rd short-term course			
4th short-term course			
19. 2nd project prog. rep.			
20. Develop. consult. progr.		XXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXX	
21. 2nd In-service train.			
22. Prep. 2nd long-term c.			
23. Short-term courses			
5th short-term course			
6th short-term course			
24. 3rd project prog. rep.			
25. 3rd In-service train.			
26. Preparat. 3r long-term			
27. Prepar 2 short-term c.			
7th short-term course			
8th short-term course			
28. Prep. terminal report			

**Manufacturing Systems Engineering Programme at A.I.T. Bangkok
Programme Activities Timetable - 1990**

-----1990-----
j f n a n j j a s o n d

1. Approval of Project (December 1989)
2. Selec. & Field. of CTA
3. Short-term specialists
 1st short-course
- 2nd short-course
4. Survey mission
5. Final Project Workplan
6. Specif. Hardw. & Softw.
7. Procurement of equipm.
8. Procuren. of Softwa.:
9. Selec. long-term exp.
10. Fielding long-term exp.
11. Prepar. differ. curricul
12. Labor. prep. & start-up
13. Training laborat. staff
14. Establ. ind. info-serv.
15. First project prog. rep.
16. First in-service train
17. First long-term course
18. Short-term courses
 3rd short-term course
- 4th short-term course
19. 2nd project prog. rep.
20. Develop. consult. progr.
21. 2nd in-service train.
22. Prep. 2nd long-term c.
23. Short-term courses
 5th short-term course
- 6th short-term course
24. 3rd project prog. rep.
25. 3rd in-service train.

26. Preparat. 3r long-term
27. Prepar 2 short-term c.
 7th short-term course
- 8th short-term course
28. Prep. terminal report

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**Manufacturing Systems Engineering Programme at A.I.T. Banghal
Programme Activities Timetable - 1991**

-----|1991|-----
j f o a n j j a s o n d

- 1. Approval of Project (December 1989)
- 2. Selec. & Field. of CTA
- 3. Short-term specialists
 - 1st short-course
 - 2nd short course
- 4. Survey mission
- 5. Final Project Workplan
- 6. Specif. Hardw. & Softw.
- 7. Procurement of equipm.
- 8. Procuren. of Software
- 9. Selec. long-term exp.
- 10. Fielding long-term exp
- 11. Prepar. differ. curricula
- 12. Labor. prep. & start-up
- 13. Training laborat. staff
- 14. Establ. ind. info-serv.
- 15. First project prog. rep.
- 16. First in-service train
- 17. First long-term course
- 18. Short-term courses
 - 3rd short-term course
 - 4th short-term course
- 19. 2nd project prog. rep.
- 20. Develop. consult. progr.
- 21. 2nd In-service train.
- 22. Prep. 2nd long-term c.
- 23. Short-term courses
 - 5th short-term course
 - 6th short-term course
- 24. 3rd project progr. rep.
- 25. 3rd in-service train.

- 26. Preparat. 3rd long-term
- 27. Prepar 2 short-term c.
 - 7th short-term course
 - 8th short-term course
- 28. Prep. terminal report

XX

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XXXXX

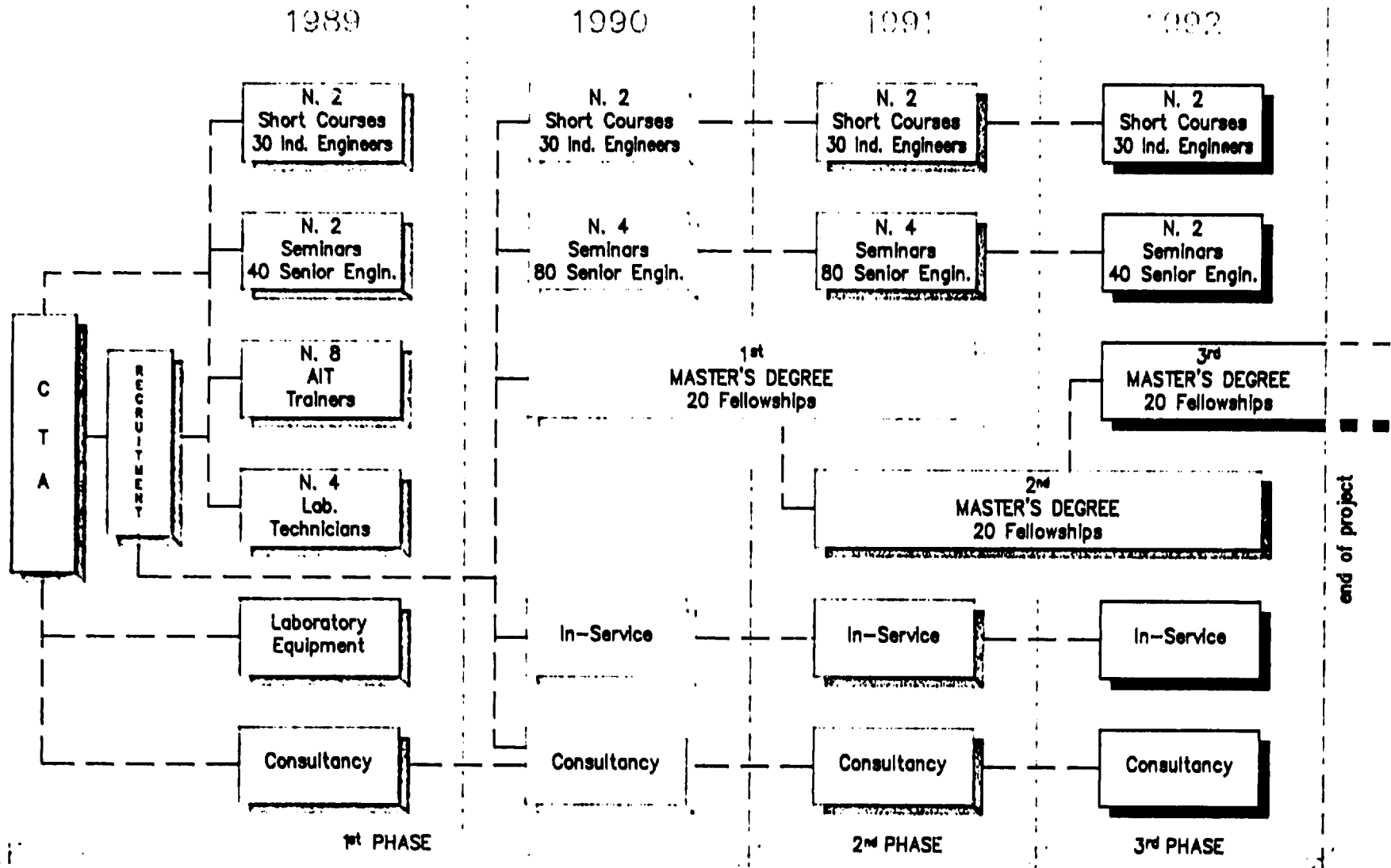
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PROJECT DEVELOPMENT



ANNEX 5

Tentative list of training equipment

a. Laboratory equipment and machinery	\$ 550,000
b. Initial software	\$ 120,000
c. First upgrade hardware	\$ 85,000
d. First upgrade software	\$ 165,000
e. Industrial Data Base Information Service	
(IDIS) upgrade existing hardware	\$ 138,000
f. IDIS Ind.Document & Software Library	\$ 190,000
g. Equipment, demonstration programs, software	
and materials for short courses, seminars,	
workshops	\$ 132,000

T o t a l E q u i p m e n t	\$ 1,380,000

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ANNEX 6

ESTIMATED PROJECT BUDGET
TOTAL

Budget lines	Components	US dollars
I	Project Personnel	
11-01	C.T.A. (in split missions) 27 m/m	\$ 243,870
11-02	Intern. experts (full time) 108 m/m	" 939,780
11-50	Short-term consultants 56 m/m	" 468,260
15-00	Project travel (within region)	" 46,000
16-00	UNIDO monit.missions (incl.joint eval.)	" 46,000
II	Subcontracts	
21-00	Subcontracts for a total of 66 m/m	" 547,250
III	Training	
31-00	Individual fellowships 1200 m/m	\$ 1,200,000
32-00	Study tours	" 180,000
33-00	In-service training (*) 75 m/m	" 237,500
IV	Equipment	
41-00	Expendable equipment	\$ 1,300,000
42-00	Non-expendable	" 80,000
V	Miscellaneous	
51-00	Reports	\$ 5,000
	Sundries	" 22,000
	Miscellaneous	" 60,000
	T O T A L	\$ 5,375,660
	Plus 13% Operational charge	" 698,836
	G R A N D T O T A L	\$ 6,074,496

(*) Subject to the origin of the target groups,
the duration of the training programme, etc..



COUNTRY REGIONAL ASIA	4. PROJECT NUMBER AND AMENDMENT US/RAS/88/	5. SPECIFIC ACTIVITY J14201
PROJECT TITLE Strengthening the capabilities of the Asian Institute of Technology (AIT) in Education/Training/Research in the Field of Manufacturing Systems Engineering.		

INTERNATIONAL EXPERTS (functional titles required except for line 11-50)	16. TOTAL		17. 1989		18. 1990		19. 1991		20. 1992	
	m/m	\$	m/m	\$	m/m	\$	m/m	\$	m/m	\$
1-01	27	243.870	9	75.150	6	52.800	6	55.200	6	60.720
02	108	939.780			36	293.400	36	307.800	36	338.580
03										
04										
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06										
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14										
15										
16										
1-50 Short term consultants	56	468.260	20	155.000	12	97.800	12	102.600	12	112.860
1-99 Sub-total—International experts*	191	1.651.910	29	230.150	54	444.000	54	465.600	54	512.160

REMARKS

Excluding 13% overcharge

* If more than 16 experts are required check here and attach continuation sheet 1A. This sub-total must include all experts.



NUMERO DU PROJET US/RAS/88	16. TOTAL		17. 1989		18. 1990		19. 1991		20. 1992	
	m-h	dollars	m-h	dollars	m-h	dollars	m-h	dollars	m-h	dollars
EXPERTS OPAS (titre fonctionnel exigé)										
01										
02										
03										
99 Total partiel - Experts OPAS ^b										
PERSONNEL D'APPUI ADMINISTRATIF										
00 Commis, secrétaires, chauffeurs										
50 Interprètes indépendants, (projets non-PNUD)										
99 Total partiel - Personnel d'appui administratif										
VOLONTAIRES DES NATIONS UNIES (titre fonctionnel exigé)										
01										
02										
03										
04										
99 Total partiel - Volontaires des Nations Unies										
00 Déplacements effectués dans le cadre du projet		46.000		16.000		10.000		10.000		10.000
00 Autres dépenses de personnel (y compris frais de mission du personnel de l'ONUDI)		46.000		10.000		11.000		12.000		13.000
EXPERTS NATIONAUX (titre fonctionnel exigé)										
01										
02										
03										
04										
05										
99 Total partiel - Experts nationaux ^b										
99 TOTAL - ELEMENT PERSONNEL	191	1.743.910	29	256.150	54	465.000	54	487.600	54	535.160

^b Si des lignes budgétaires supplémentaires sont nécessaires, utiliser le case suivante [] et pointer au feuillet complémentaire 1A. Ces totaux partiels doivent inclure les lignes budgétaires de la page 1A.



PROJECT NUMBER US/RAS/88	16. TOTAL		17. 1989		18. 1990		19. 1991		20. 1992	
	m/m	\$	m/m	\$	m/m	\$	m/m	\$	m/m	\$
SUBCONTRACTS										
00 Subcontracts		547.250		186.000		130.400		136.800		94.050
TRAINING										
00 Individual fellowships	1200	1.200.000			400	380.000	400	400.000	400	420.000
00 Study tours: UNDP group training ITALY	60	180.000			20	55.000	20	60.000	20	65.000
00 In-service training	75	237.500			25	75.000	25	80.000	25	82.500
00 Non-UNDP group training										
00 Non-UNDP meetings										
99 TOTAL—TRAINING COMPONENT	1335	1.617.500			445	510.000	445	540.000	445	567.500
EQUIPMENT										
00 Expendable equipment		1.300.000		1.000.000		200.000		100.000		
00 Non-expendable equipment		80.000		20.000		20.000		20.000		20.000
00 Premises										
99 TOTAL—EQUIPMENT COMPONENT		1.380.000		1.020.000		220.000		120.000		20.000
MISCELLANEOUS										
00 Supplies		87.000		27.000		20.000		20.000		20.000
00 Hospitality (non-UNDP projects)										
00 Support costs (CC and DC projects only)										
99 TOTAL—MISCELLANEOUS COMPONENT		87.000		27.000		20.000		20.000		20.000
SURPLUS/DEFICIT										
00 Surplus/Deficit (ADM/FS use only)										
99 PROJECT TOTAL	1526	5.375.660	49	1.489.150	499	1.345.400	499	1.304.400	499	1.236.710
° COST SHARING (UNDP/IPF projects only)										
° NET UNDP CONTRIBUTION										