ECONOMIC COMMISSION FOR AFRICA
Joint Meeting of ECA and OAU
on Telecommunications in Africa
Addis Ababa, 7 - 12 March, 1966

TRAINING OF INSTRUCTORS FOR
AFRICAN TELECOMMUNICATION INSTITUTES

M66-55
* Important

See this series of courses
in the 10 year integrated
programme attached
Telecommunication Specialist from Africa instructing his Colleagues on Teleprinter Maintenance during an Overseas Training Course.
TRAINING OF INSTRUCTORS FOR
AFRICAN TELECOMMUNICATION INSTITUTES

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Summary

The lack of trained technical staff is a limiting factor in the development of telecommunications in Africa and the finding of a solution to this problem is a matter of considerable urgency.

Under the joint ECA/ITU action two major training programmes are proposed, one for management at directors' level, and one for technical instructors for African telecommunication training institutes. Both programmes are scheduled to start in 1965.

This report concerns the training of technical instructors, with the aim of providing a permanent solution to the training of technical staff for telecommunication installations and ultimately of overcoming dependency on foreign resources in this field.

The training programme is set out initially for a target figure of 450 instructors, utilizing the recently created and modern facilities of the "ILO Turin Centre for Advanced Training" in Italy.

A schedule of operations covering the period 1965 to 1972 is given together with cost estimates.

The administration of the programme would be entrusted to the ITU.
1. Introduction

At their sixth session, the Economic Commission for Africa drew attention to the urgent need for training personnel in the various branches of telecommunications. 1/

A permanent and basic solution to the problem is the training of telecommunication instructors. Looking into the future this is the key to training problems and more far reaching benefits may be realized than through the continued employment of expatriate staff whose services are costly to maintain indefinitely and are becoming increasingly difficult to procure.

It will be necessary that the training programmes for these instructors be adapted to African needs and that the teams of instructors should return to their home countries upon graduation and take up duties in the national telecommunication institutes. These teams would have the responsibility of imparting knowledge to future African telecommunication technicians and must therefore receive a solid grounding in all aspects of the subjects they will be called upon to teach.

With this in view the ECA/ITU propose that a series of special, intensive courses be set up in collaboration with ILO, for the training of telecommunication instructors at the "Turin Centre for Advanced Training" of the ILO. The courses are planned to be of four years duration, broken by a home leave, and it is thought that a start could be made in 1965. The first group would therefore graduate in mid 1969. The programme envisages the training of 450 instructors in four courses over a period of 7 years. This would provide between 10 to 15 instructors specialized in several fields of telecommunications per country.

1/ Resolution 106(VI) on the Development of Telecommunications in Africa
This programme is an integral part of the overall working programme for the development of telecommunication services in Africa. Under the overall programme it is intended, amongst other things, that an extensive review be made of existing national training facilities and that these be created or expanded as required to meet future needs. It is therefore of paramount importance to have available an adequate supply of technical instructors. In this regard it is of interest to note that the average cost of training a national instructor is comparable to the yearly cost of the services of an internationally recruited instructor.

By way of comparison it is estimated that there will be a tenfold increase in student enrolment for higher education in Africa over the period 1961-1980 with a consequent proportional increase in teaching staff over that period. This explosion can only be met by taking action without delay. Therefore, it is strongly recommended that a concerted effort be made to start the suggested programme at the beginning of the next scholastic year in September 1965.

A simultaneous start with students from countries throughout Africa will permit uniform development in this field throughout the Continent and offers the possibility of an economical solution within the spirit of African Unity.

2. Proposed Courses

The proposed schedule of operations, shown diagramatically in Annex A, covers the setting up of four four-year courses to cater for a total of 450 prospective instructors.

It is proposed to commence in September, 1965 with a 200-man four-year course divided in eight classes each of 25 students. This should be followed by a second and third course each of 100 students, commencing in 1966 and 1967 and two classes in 1968 with a total of 50 students. This will give 200 instructors by 1969 and a total of 450 trained instructors by 1972 which is at least one instructor in special subjects of telecommunication for each country. The actual needs will have to be reviewed from time to time, and the programme adjusted if necessary according to the real situation as the courses progress.

Of the eight classes in the first course it is proposed to have one in each speciality, however, because of language considerations, four would be in English and four in French, as shown in Annex B: "Breakup of Courses". The succeeding courses would be in the alternate language and at the completion of the four courses there would be 25 instructors trained in English and in French for each speciality (except radio communication in which there should be 50 in each language).

The courses proposed offer general training with a choice of followed specialization by instruction on training methods. The proposed structure of the courses has been drawn up and is shown in Annex C: "A Draft 4 Year Training Course for African Telecommunication Instructors".

The general instruction is intended partly as a refresher course and at the same time to bring up those who have not had advanced training before, to a common level. In addition general culture, instruction in methods of self development and artistic activities will be included to expand their education.
The general instruction comprises:

1. **Telecommunication principles** - elementary electricity to modulation, transmission and radiation
   - arithmetic, trigonometry, geometry
   - mechanics, basic chemistry and physics
   - world and African topography, maps and map reading
   - international and public administration
   - government financing, foreign exchange, importing, exporting, banking, tariffs
   - speech improvement, chairing meetings, preparation of reports and correspondence
   - development of reading, outside interests, sport
   - government organization, efficient management and budgeting

While the general instruction continues throughout the four years, during the second year some specialization is introduced and continues through the remaining three years. The proposed courses on specialized subjects are as follows:

1. **Management Services** - organization and methods, personnel management, stores and contracts, automatic data processing, operations research, finance, accounting, radio regulations
2. **Engineering Science and Mathematics** - mechanics - mass, force, acceleration, work, speed ratio, strength of materials, structures
   - chemistry - cells, properties of metals, etc.
3. Radio Communications

- physics - effects of electric current, magnetism, etc.

- mathematics - fractions, logarithms, -
  areas, algebra, statistical and experimental graphs, trigonometry,  
calculus, complex numbers

- modern methods for the transmission and reception at MF, HF, VHF,  
SHF (including space communications) aerial systems, measurement techniques,  
modulation, multiplexing, power plant

4. Telephony Systems

- relays, signalling, switching -
systems, traffic and trunking,  
power plant, telephone instruments,  
automatic exchanges - step by step,  
relay, rotary, cross bar, motor uni-selector, electronic

- codes, signalling, relays, tele-
printers, voice-frequency systems,  
faksimile, tape relay systems,  
switching, radio-telegraphy,  
power plant, ARQ systems

5. Telegraphy Systems

- propagation along lines and cables,  
noise, crosstalk, carrier telephone  
and telegraphy, testing, powerplant,  
modulation, wide band systems,  
carrier frequency generation, screening  
and earthing, signal to noise ratios,  
filters, multiplexing

6. Line Transmission

- properties of poles, wires, concrete,  
methods of erection, manholes,  
cables-screened, carrier and coaxial,  
jointing, radio aerial construction,  
line requirement forecasting,  
induction, corrosion, loading,  
testing

7. Lines and Cables
   (Outdoor Plant)

- woodwork, metalwork, welding,  
painting properties of materials,  
plans, geometry, layout of drawings,  
wire and circuit diagrams,  
combustion engines, power  
generating plant
During the third and fourth year, instruction would be given on functional training, that is, teaching the students how to teach and how to manage their institutions. The subjects include:

1. Comparative study of training systems: apprenticeships, accelerated training, technical instruction, training for promotion

2. Estimating training costs, manpower needs and training

3. Management of establishments: staff, investments, effective use of facilities, depreciation

4. Teaching techniques: the learning process, programme planning, programmed instruction, analysis and preparation of systematic progression methods (unit exercises), instruction progress control

5. Organization: work organization, layout of place, social activities

3: Fellowships, Teachers and Equipment Required

The total of 450 fellowships would be required under this programme. These fellowships would have to cover:

(a) A fixed salary from which would be deducted the board and lodging provided by the Turin Centre.

(b) The cost of return air travel including a home leave which is proposed after two years' absence. The cost of local travel during "vacation" periods when trainees would be attached to private or governmental organizations to gain practical experience. (Interested governments might be invited to contribute towards the cost of fares).
(c) The cost of general tuition provided by the Turin Centre.
(The exact cost is not known at this stage but it is assumed for the purpose of this estimate to be US$ 100.00 per year per fellow).

The summary of fellowship costs are given in Annex D: "Cost of Fellowships".

It would be also necessary to provide teaching staff for the specialized subjects and an allocation has been made for a total of 83 man years for this purpose. See Annex E: "Number and Cost of Specialized Teaching Staff Required". It is assumed that the general subjects shown in the programme (Annex C) would be given by the teachers attached to the Turin Centre and that their services and other facilities will be covered under the fee mentioned above.

In addition to fellowships and teaching staff costs, there would be required an allocation for equipment for the specialized courses. Here again it is assumed that equipment for the general subjects would be provided by the Turin Centre.

A general idea of the types of equipment required is as follows:

**Telecommunication Principles**
Power supplies; meters; oscilloscopes; electromagnets, coils, condensers, transformers; audio and radio frequency generators with AM and FM modulation; wobulators, simple detector and modulator units; audio amplifiers; demonstration units.

**Engineering Science**
Modern students experimental models for mechanics, chemistry and physics.

Radio communications (see also telecommunication principles)
High-frequency receivers and transmitters; VHF receiver and transmitter UHF radio-relay unit; measuring equipment, noise, distortion, field strength, impedance; model aerial measuring unit.

**Telephony**
Relay units and special adjusting tools; measuring equipment; elementary switching unit; test desk; demonstration models of telephone exchanges.
Transmission (see also telecommunication principles, radio communications)

12 channel carrier system, level and frequency measuring instruments

Lines and Cables
Poles, wire, cables, etc. for erection. Measuring instruments and tools. Cable testing and balancing van

General

In addition it is proposed to establish a specialized library of books and periodicals together with programmed material on each of the courses. Further it is recommended to issue to each student books and hand tools which he may retain as a basis of his reference library and to encourage him to undertake practical repair and installation work himself.

Precise details of the equipment to be purchased must be worked out so as to ensure co-ordination with the facilities available at the Turin Centre; however, a first estimate of the cost of the above items is given for budgetary purposes in Annex IV: "Cost of Specialized Equipment".

4. Finance

The whole scheme will require substantial assistance from organizations, governments and other entities for its successful implementation. It is suggested that the Executive Secretary of ECA be authorized by the Commission to explore in consultation with the Secretary Generals of the ILO and of the ITU the question of obtaining the necessary financial assistance from the various sources.
The total estimated cost over 7 years expressed in US Dollars is as follows:

<table>
<thead>
<tr>
<th>Description</th>
<th>Cost</th>
</tr>
</thead>
<tbody>
<tr>
<td>Fellowships, travel and general tuition</td>
<td>$6,210,000</td>
</tr>
<tr>
<td>Specialized Teaching Staff</td>
<td>$830,000</td>
</tr>
<tr>
<td>Equipment</td>
<td>$560,000</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td><strong>$7,600,000</strong></td>
</tr>
</tbody>
</table>

Miscellaneous local costs of recruitment and internal travel have not been included in these totals. The above cost figures represent the foreign exchange component of the programme. It appears unlikely that any major contributions would be forthcoming in foreign exchange from the recipient countries. Since many countries operate their own airlines it should be expected that they will provide at least part of the travel expenses as well as local expenses such as the support of families, etc. It is essential that those terms be clarified beforehand to avoid hardship to the students and interruption of studies.
Annex A: Proposed Schedule of Opera

1964
- 7th Session
- ECA approves programme in principle
- Joint ILO UNESCO-ITU programme prepared
- ECA/ITU present formal request for funds
- Turin Centre invites applications for teachers

1968
- Governments invite applications for fellowships (200)

1969
- 1st Course ends

1970
- 2nd Course ends

1971
- 3rd
ANNEX A

Proposed Schedule of Operation

Suggested chronological order of action in setting up the courses is as follows:

It is proposed to formally present this proposal to the seventh session of ECA in February 1965. After acceptance, the interested governments could invite applications for fellowships through their respective telecommunications administrations for the various specialities proposed for the first course (in English - Management Services, Telephony, Line Transmission, Workshop Practices; in French - Engineering Science and Mathematics, Radio communications, Telegraphy, Lines and Cables). The selection of the trainees would be made in May 1965 for the first course by a joint committee comprising the interested Governments, representatives of the ILO and ITU by means of questionnaires and interviews. Information given regarding the health, occupational qualifications, character, behaviour, skill, knowledge and aptitudes, educational record and cultural background of each candidate would be required. This information would be checked by the joint committee in the region concerned as well as by the Turin Centre's testing experts.

In the meantime the Joint ECA/ITU Mission could formally request funds and arrange with the Turin Centre to invite applications for the nine teachers, for the specialised subjects (See Annex B) plus those for general tuition, if required. At the same time offers for the equipment required for the first year could be invited.

The allocation of funds would be required to be approved in May and action could then be taken by the Turin Centre to formally accept the joint committee's nominations, appoint the teachers and order the equipment by June. The Turin Centre could then proceed with arrangements for the teachers to take up duty a month before the course commenced in September and to arrange for the installation of the equipment.

Once formal acceptance is advised by the Turin Centre the various governments could proceed with drawing up a contract with the prospective instructors and make the necessary arrangements for their departure.
(inoculations etc.) during the last two weeks in August. Under this scheme funds would be made available for international air travel from the country of origin to Turin and it is assumed that all incidental expenses and internal and possibly overseas travel would be borne by the government. Salaries payable under this scheme would commence the day of departure from the country of origin and an advance against the salary is proposed for outfitting. The salary has been tentatively fixed at US$ 200.-- per month plus US$ 25.-- for each recognized dependent. It is proposed that the salary be determined by the candidate's marital and dependency status at the date of acceptance and that it be reviewed annually.

The form of the agreement between the government and prospective instructor is a question for the Government, however, for the sake of uniformity preference should be given to trainees having a contract which guarantees the prospective instructor a teaching position and salary commensurate with his qualifications, and on his part, binds him to fill this position for not less than four years.

The prospective instructor would be required to complete four years of training which includes two periods of practical experience and one home leave.

It is proposed that the second four-year course should start in September 1966 with 100 students, this would be followed by a third course of 100 students and a fourth of 50 students. However, it is nevertheless proposed to review the whole programme periodically, possibly at each session of the ECA, and so give the governments the opportunity to participate actively in this scheme as it develops.
## ANNEX B

### Breakup of Courses

<table>
<thead>
<tr>
<th>Speciality</th>
<th>Number of classes in course</th>
<th>Classes x students = Sub-totals</th>
</tr>
</thead>
<tbody>
<tr>
<td>Management Services</td>
<td>1E  1F</td>
<td>2 x 25 = 50</td>
</tr>
<tr>
<td>Engineering science and mathematics</td>
<td>1F  1E  1E</td>
<td>4 x 25 = 100</td>
</tr>
<tr>
<td>Radio communication</td>
<td>1E  1F  1F  1E</td>
<td>2 x 25 = 50</td>
</tr>
<tr>
<td>Telephony systems</td>
<td>1F  1E</td>
<td>2 x 25 = 50</td>
</tr>
<tr>
<td>Line Transmission</td>
<td>1E  1F</td>
<td>2 x 25 = 50</td>
</tr>
<tr>
<td>Line and cables</td>
<td>1F  1E</td>
<td>2 x 25 = 50</td>
</tr>
<tr>
<td>Workshop practices</td>
<td>1E</td>
<td>2 x 25 = 50</td>
</tr>
<tr>
<td>Totals</td>
<td>8(4F 4E) 4(2F 2E) 4(2F 2E) 2(1F 1E)</td>
<td>18 x 25 = 450</td>
</tr>
</tbody>
</table>

Note:  
F = Class in French  
E = Class in English
### Annex C: Draft 4 Year Training Course for African Telecommunication Instructors

<table>
<thead>
<tr>
<th>Year</th>
<th>Percentage of Time</th>
<th>10</th>
<th>20</th>
<th>30</th>
<th>40</th>
<th>50</th>
<th>60</th>
<th>70</th>
<th>80</th>
<th>90</th>
<th>100</th>
</tr>
</thead>
<tbody>
<tr>
<td>1st Year</td>
<td>Telecommunication principles</td>
<td></td>
<td></td>
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<tr>
<td>2nd Year</td>
<td>Telecommunication principles</td>
<td>Management (Organization and Methods, Finance)</td>
<td></td>
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<td>September</td>
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<td></td>
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</tr>
<tr>
<td>3rd Year</td>
<td>Telecommunication principles</td>
<td>Personnel Management</td>
<td>Stores &amp; contracts</td>
<td>Accounting</td>
<td>Radio communications</td>
<td>Organization Management &amp; Budgeting</td>
<td>Teaching Techniques</td>
<td>Oral &amp; Written expression</td>
<td></td>
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<td></td>
</tr>
<tr>
<td>September</td>
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</tr>
<tr>
<td>4th Year</td>
<td>Advanced Telecommunication Practices</td>
<td>Automatic data processing, Operations research</td>
<td>Functional training (Training systems, learning processes, teaching techniques, management etc.)</td>
<td></td>
<td></td>
<td></td>
<td></td>
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</tr>
</tbody>
</table>

Time blocks with asterisk are assumed to be given by Turin Centre staff under "general" tuition or in the case of practical experience by private or governmental organizations.
### Cost of Fellowships

<table>
<thead>
<tr>
<th>Year</th>
<th>Course 1</th>
<th>Course 2</th>
<th>Course 3</th>
<th>Course 4</th>
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<tbody>
<tr>
<td>1955/56</td>
<td>20,000</td>
<td>20,000</td>
<td>60,000</td>
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<td>1956/57</td>
<td>20,000</td>
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<tr>
<td>1957/58</td>
<td>5,000</td>
<td>10,000</td>
<td>5,000</td>
<td>150,000</td>
</tr>
<tr>
<td>1958/59</td>
<td>5,000</td>
<td>10,000</td>
<td>5,000</td>
<td>150,000</td>
</tr>
<tr>
<td>1959/60</td>
<td>5,000</td>
<td>10,000</td>
<td>5,000</td>
<td>150,000</td>
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<tr>
<td>1960/61</td>
<td>5,000</td>
<td>10,000</td>
<td>5,000</td>
<td>150,000</td>
</tr>
</tbody>
</table>

#### Cost Details

- **Tuition**: US$ 1000 per annum.
- **Local Travel**: $100 per annum.
- **Round Trip Course 1**: $600.00.
- **Travel**: $600.00 per annum.
- **Home Leave**: $300.00.

**General**:
- Tuition is assumed at US$ 1000 per annum.
- Specialized Tuition is given by staff provided under this budget.

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List of tables:
- Table 1: Cost of Fellowships

**Annex D**

Assumed at US$ 250 per month covering all allowances and from which is deducted board and lodging.
Table: Number and Cost of Specialized Teaching Staff Required

<table>
<thead>
<tr>
<th>Subject</th>
<th>Language</th>
<th>Total Staff</th>
<th>Total Cost</th>
</tr>
</thead>
<tbody>
<tr>
<td>Telecommunication</td>
<td>English</td>
<td>160</td>
<td>230.000</td>
</tr>
<tr>
<td>Mathematics</td>
<td>English</td>
<td>125</td>
<td>180.000</td>
</tr>
<tr>
<td>Engineering</td>
<td>English</td>
<td>110</td>
<td>160.000</td>
</tr>
<tr>
<td>Management</td>
<td>English</td>
<td>90</td>
<td>120.000</td>
</tr>
<tr>
<td>Total Teach.</td>
<td>English</td>
<td>480</td>
<td>680.000</td>
</tr>
</tbody>
</table>

Assumed at US$10,000 to cover salary, special allowances, travel, home leave and other costs.

Note: 2 teachers for 80% of the total time, that is 40% each. By the term 'total time', the percentage time is given and the number of teachers. 80% means for specialized subjects only. Those for regular subjects assumed to be provided.

Annex E
<table>
<thead>
<tr>
<th>Item</th>
<th>5/6/70</th>
<th>6/0/70</th>
<th>6/17/70</th>
<th>7/0/71</th>
<th>7/1/71</th>
<th>1/1/72</th>
<th>2/1/72</th>
<th>3/1/72</th>
<th>4/1/72</th>
<th>5/1/72</th>
</tr>
</thead>
<tbody>
<tr>
<td>Total</td>
<td>2,000</td>
<td>2,000</td>
<td>2,000</td>
<td>2,000</td>
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<td>1/1/72</td>
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Cost of Specialized Equipment

Annex B
ANNEX G

Summary of Costs

(Expressed in thousands of dollars)

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<tr>
<td>Fellowships, travel</td>
<td>760</td>
<td>1,000</td>
<td>1,450</td>
<td>1,500</td>
<td>845</td>
<td>500</td>
<td>155</td>
<td>6,210</td>
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<td>and general tuition</td>
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<tr>
<td>Specialized Teaching</td>
<td>90</td>
<td>160</td>
<td>230</td>
<td>180</td>
<td>110</td>
<td>50</td>
<td>10</td>
<td>830</td>
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<tr>
<td>Staff</td>
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<tr>
<td>Equipment</td>
<td>119</td>
<td>308</td>
<td>52</td>
<td>49</td>
<td>15</td>
<td>11</td>
<td>6</td>
<td>560</td>
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<tr>
<td>Total</td>
<td>$969</td>
<td>$1,468</td>
<td>$1,732</td>
<td>$1,775</td>
<td>$970</td>
<td>$561</td>
<td>$171</td>
<td>$7,600</td>
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Cost per trainee per year = US$ 4,200.---
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<tbody>
<tr>
<td><strong>DEVELOPMENT OF TELECOMMUNICATIONS IN AFRICA</strong> <strong>ECA-ITU SUGGESTED 10 YEARS PROGRAMME</strong></td>
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<tr>
<td><strong>POLICY</strong></td>
<td>OAU Meeting (CAIRO)</td>
<td>ECA</td>
<td>ITU Regional plan committee</td>
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<tr>
<td><strong>FINANCE</strong></td>
<td>Establishment of financing scheme (ADB etc.)</td>
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<td><strong>PROGRESS EVALUATION</strong></td>
<td>(ECA-ITU periodic review and report)</td>
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<td><strong>NETWORK</strong></td>
<td>1st STAGE</td>
<td>INSTALLATION (Low capacity systems) US $ 37 million, approx.</td>
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<td></td>
<td>2nd STAGE</td>
<td>INSTALLATION (High capacity systems) US $ 900 million, approx.</td>
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<td><strong>TRAINING</strong></td>
<td>DIRECTORS</td>
<td>Joint ECA-ILO-ITU PROGRAMME (TURIN CENTRE) US $ 1 million, approx.</td>
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<td>INSTRUCTORS</td>
<td>US $ 8 million, approx.</td>
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<td>INSTITUTES</td>
<td>US $ 65 million, approx.</td>
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<td></td>
<td>PUBLICATIONS</td>
<td>US $ 1 million, approx.</td>
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<td><strong>ALLIED PROGRAMMES</strong></td>
<td>(in progress)</td>
<td>SPECIAL FUND</td>
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