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Regional Expert Group Meeting on
Human Resources Development in Industrial
Maintenance in Africa Preparatory to the
Second Consultation on the Training of
Industrial Manpower

Nairobi, Kenya, 23-27 June 1986

REPORT*. (Meeting on training in industrial maintenance in Africa).

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37

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PREFACE

The System of Consultations

The Second General Conference of the United Nations Industrial Development Organization (UNIDO), held at Lima, Peru, in March 1975, recommended that UNIDO should include among its activities a system of continuing consultations between developed and developing countries with the object of raising the share of developing countries in world industrial output through increased international co-operation[1/]. The General Assembly, at its seventh special session in September 1985, endorsed the recommendation and requested UNIDO to implement it under the guidance of the Industrial Development Board.

In May 1980, the Industrial Development Board decided to establish the System of Consultations on a permanent basis, and in May 1982 it adopted the rules of procedures[2/] according to which the System of Consultations was to operate, including its principles, objectives and characteristics, notably:

(a) The System of Consultations should be an instrument through which UNIDO would serve as a forum for developed and developing countries in their contacts and consultations directed towards the industrialization of developing countries;[3/]

(b) Consultations would also permit negotiations among interested parties at their request, at the same time as or after consultations;[4/]

(c) Participants of each member country should include officials of Governments as well as representatives of industry, labour, consumer groups and others, as deemed appropriate by each Government;[5/]

(d) Final reports of the Consultations should include such conclusions and recommendations as were agreed upon by consensus by the participants: the reports should also include other significant views expressed during the discussions.[6/]

1/ Report of the Second General Conference of the United Nations Industrial Development Organization (ID/CONF.3/31), Chap. IV, "The Lima Declaration and Plan of Action on Industrial Development and Co-operation", para.66.

2/ See Draft rules of procedure for the System of Consultations (ID/B/258), annex.

3/ Official Records of the General Assembly, Thirty-fifth session, Supplement No. 16 (A/35/16), Vol. II, para. 152(a).

4/ Ibid., para. 151(b)

5/ Ibid., para. 152

6/ Ibid., Thirty-second session, Supplement No. 16 (A/32/16), para. 163.

INTRODUCTION

First Consultation on Training of Industrial Manpower

The First Consultation on Training of Industrial Manpower[1/] which was held in Stuttgart, Federal Republic of Germany, 22-26 November 1982, recommended inter alia that UNIDO should, through inter-secretariat consultations, co-ordinate with other UN agencies (especially ILO and UNESCO) and other established mechanisms at headquarters and country levels, strengthen its capacity and programmes to assist developing countries in building up coherent and comprehensive training systems through the development of adequate methodologies for the determination of manpower and training needs, for training of trainers, specialists, managers, supervisors and other cadres on a permanent basis, and for the collection and dissemination of information relevant to industrial training.

Second Consultation on Training of Industrial Manpower

During its 19th session in May 1985, the UNIDO Board defined the programme of Consultations for the biennium 86/87, and gave the mandate to the Organization to carry out the necessary preparatory activities for the Second Consultation on the Training of Industrial Manpower.

The Second Consultation on the Training of Industrial Manpower is expected to be convened in Paris, France, in September 1987.

The objectives of the Second Consultation are:

- To promote the development of human resources as a key factor for the futherance and mastery of the industrialization process and technological development in developing countries.

- To consider selected and specific issues, with the aim of adopting action-oriented programmes of a practical character, for the assistance and guidance of member states towards the development of human resources for industrialization.

- To strengthen the role of UNIDO as a catalyst and an instrument in the development of human resources for industry through the stimulation of practical and co-ordinated action between developed and developing countries and developing countries themselves, UN Organizations, regional and other institutions.

1/ See report ID/294

Preparations for the Second Consultation on Training of Industrial Manpower

The UNIDO Secretariat determined a line of action for the Second Consultation on experience gained from the First Consultation, on the various recommendations on industrial training addressed to it in various meetings, on its mandate as a specialized Agency where industrial training continues to be accorded priority consideration, and on close contacts with other relevant UN agencies, especially ILO and UNESCO. The orientation for the Second Consultation4/ was discussed at the High-Level Expert Group Meeting which met in Paris, from 13-16 January 1986 8/, with the participation of various experts from Member States and key international/governmental organizations (ILO, World Bank, OECD, EEC, etc...). The meeting agreed on the two issues proposed by the Secretariat:

Issue A: Human Resources Development for Industrial Maintenance

Issue B: Human Resources Development for Mastering Technological Changes in Industry.

The meeting stressed the importance of convening a specific expert group meeting on Issue A related to African Region, in view of the priority importance of the subject in Africa and of the more action-oriented character of the work at a regional level. A Second Regional Meeting was suggested to consider Issue B in more detail, funds permitting.

The meeting identified 6 priority areas for action within the scope of Issue A, namely, human resources development with respect to:

- maintenance policy and strategy;
- training policy for maintenance;
- negotiation and acquisition of capital goods;
- organization and methods of maintenance;
- technical documentation on maintenance;
- spare parts (manufacture and management).

8/ See Document ID/WG.463/4 (Paris Report).

Preparation for the Regional Expert Group Meeting on Human Resources Development in industrial maintenance in Africa

In preparation for the meeting under review the under-mentioned two technical papers were prepared by UNIDO consultants:

"Guide for Action in the Field of Human Resources Development for Industrial Maintenance in Africa"9/.

"Investment in Maintenance: Economic Stakes and Possible Strategies"10/.

Furthermore, an innovative approach was adopted for this meeting in that all experts from African countries have been asked to prepare a national case study on human resources development in industrial maintenance in their individual countries in accordance with a guide prepared by the Secretariat. (See Annex No. 3). This approach follows the reasoning that it is national experts who are better aware of the problems facing their particular countries and what solutions may be propounded to overcome them. It also shows the faith of UNIDO in the capability of experts from developing countries.

ILO, UNESCO and UNIDO collaborated in the preparation for the meeting.

9/ Consultant Mr. P. De Groote (Belgium)
10/ Consultant Mr. C. Pichot (France)

CONCLUSIONS AND RECOMMENDATIONS

The following conclusions and recommendations were adopted by the meeting:

ISSUE A: NATIONAL STRATEGY FOR MAINTENANCE

A. Conclusions

1. Industrial maintenance is a key factor in the industralization process of African countries. In spite of the fact that the problem has been known and discussed for many years, the lack of or poor industrial maintenance continues to constitute a major obstacle in industrial development, and indeed, the problem is growing.

2. The awareness of the importance of industrial maintenance has been growing mainly among technical personnel, but the key decision-makers in Government and industry have not been sensitized to a sufficient extent to make them take tangible positive action. In view of this, the right policies and strategies at Government and enterprise levels have not been formulated and established in the majority of African countries.

3. There continues to be poor coordination among actors in the educational and training fields, with regard to human resources development for industrual maintenance. The mis-match between education and training and the needs of industry in the field of industrial maintenance which has featured for long in discussions, has not been rectified.

4. It is noted that in certain countries, non-governmental organizations such as Associations of Maintenance Engineers, Associations of Manufacturers, etc are contributing towards the improvement of maintenance in Africa.

B. Recommendations

Preamble to recommendations:

The participants appreciate that the problem of maintenance permeates all sectors of the economy of developing countries and that maintenance policies and strategies should be formulated to encompass all productive sectors. However, in view of the UNIDO consultation in the training of industrial manpower, they are constrained to refer only to industrial maintenance. Therefore, the participants propose that the following two recommendations apply on a multi-sectoral basis, but they concentrate their action-oriented proposals only to the industrial sector.

I. Policy recommendations to Governments, and other concerned Institutions/Actors

1. Establish or strengthen on a priority basis a national maintenance strategy including education and training in order to optimise the efficiency of capital investment through a real increase in the availability of capital equipment through better maintenance and conservation methods at a total minimum cost. This strategy should have an integrated approach through cohesive actions in various economic sectors and levels in the following fields:

- acquisition, design and use of capital equipment;
- organization and methods of maintenance;
- material means (technical documentation, spare parts, tools, etc);
- financial means;
- human resources;
- socio-economic and cultural environment.

2. Set up a National Maintenance Body as an instrument to implement the strategy in 1. above. The functions of this Body may include:

- advising Government on maintenance strategy;
- rendering technical assistance and consultancy services in maintenance;
- organizing training activities;
- coordinating the activities of existing structures such as national education system and professional training facilities within or outside enterprises;
- ensuring the matching of educational programmes with the needs of industry in industrial maintenance;
- creating awareness of policy-makers, industrial managers, maintenance personnel and the public at large on the importance of maintenance in economic and industrial development.

3. Set up suitable training programmes in order to develop human resources for the formulation of policies and strategies in maintenance, for the setting up and management of the National Maintenance Body, and for executing all its functions.

4. Encourage the creation of national fora (associations, etc) to strengthen human resources development for maintenance.

II. International cooperation

5. The exchange of experience among African countries should be promoted through the establishment of a regional centre. In this regard, since ARCEDEM's activities encompass the industrial sector for the whole of Africa, due consideration be given to the establishment of this centre within its complex.

III. UNIDO Technical Assistance

6. Provide technical assistance to Governments in the implementation of Recommendations Nos: 1, 2 and 3.

7. Consider the possibility of financing of Recommendation No. 4 through funds available under its IDDA programme, failing which, to endeavour to secure suitable financing from donors.

8. Organize regular meetings of panel of experts to monitor industrial maintenance activities.

IV. Cooperation between UNIDO and Governmental and Non-Governmental Organizations

9. UN inter-agency activities with regard to maintenance training should be strengthened. UNIDO should initiate the formation of a UN inter-agency Task Force for maintenance to coordinate and promote actions, UNIDO taking the catalyctic role.

10. UNIDO should promote the exchange of maintenance personnel between similar factories in developing countries, each company paying the expenses of training in its own country.

11. With the support of the respective governments, direct cooperation should be developed between UNIDO and non-governmental organizations engaged in activities to improve maintenance such as associations of maintenance professionals, associations of manufacturers and companies offering maintenance services.

ISSUE B: TRAINING POLICY AND MAINTENANCE

A. Conclusions

1. Effective maintenance depends on training - in two senses: technical competence, and a correct attitude: "the spirit of maintenance".

2. In many African countries at the present time there is a mis-match between training resources for maintenance, and the needs of the users in industry.

(i) Despite great improvements in recent years there is still too little good quality technical education in relation to general education to provide the necessary training base for industry;
(ii) Alternatively (or in addition) the social status of technical education in relation to academic education is still low in the eyes of the public.

3. Even when sufficient technical education and training exists it does not always satisfy the needs of industry:

(i) At vocational training level because skills are not systematically combined together so as to produce specialized maintenance workers;
(ii) At higher education level because the changing technological needs of industry are not reflected in the syllabuses taught, which in some cases may be many years behind the times.

4. The preparation of an effective maintenance worker or engineer must always have two stages:

(i) Basic technical education and training, and in addition,
(ii) Specific knowledge and experience of machines and processes, which can only be gained on the job, under qualified supervision, after leaving the general training centre or university.

In the case of a maintenance engineer or supervisor there is a further need for training in the management of maintenance, which requires knowledge of costing and supplies control as well as of technology.

5. Depsite the fact that fully trained maintenance workers and engineers must in general be more versatile and technically experienced, in the way described, it appears that in many cases their status as maintenance personnel is actually lower than comparable status in other departments. This reduces their effectiveness, and creates difficulties in retaining their services after they have been trained.

6. While many experiences on these subjects are negative, there are countries in Africa which have made better progress and whose examples could be copied by others. For example, the new national education policy of Kenya not only lays heavy emphasis on the importance of technical and vocational education, but also takes into account the need to give children and young people actual materials to work with, in order to familiarize themselves in practice with what they learn about in school. Similarly in Côte d'Ivoire a positive effort is made to ensure a match between the syllabus taught in schools and colleges and the needs of industry.

7. Taking into account the fore-going situation it was considered that the national human resources development policy of each developing country (depending on its particular circumstances) should therefore put emphasis on the following:

- The country's total needs for trained maintenance personnel, at all levels from skilled workers to engineers. These needs should be quantified, and at each level appropriate education and training should be planned and provided, to overcome the mis-matches presently experienced by industry, as described above;.
- Standards of maintenance are generally low on account of inadequate knowledge and skill of workers already in employment. Therefore the national human resources development policy should also provide for in-service training of older workers, (taking into account that different training methods may be needed for this age group);
- Special attention must be given to certain maintenance skills of critical importance to industry, including electronics and instrumentation;

- Changing technology means that maintenance of modern machines is becoming more and more a matter of knowledge, and less of manual skills. Especially in electronically controlled machinery this makes fault diagnosis a matter of intellectual logic, and there is a need for improved methods of training maintenance workers and technicians.

8. Accordingly training and sensitization for maintenance is required at all of the following levels:

- Operators and skilled workers;
- Technicians and supervisors;
- Engineers and managers;
- Government policy-makers
- The public (since improvement in national maintenance standards requires a "spirit of maintenance" on the part of the entire population).

9. Effective training for maintenance on a national scale will require coordinated effort on the part of all of the following:

- Schools, colleges, polytechnics and universities;
- The national industrial training system;
- Management training organizations;
- Industry itself;
- Maintenance experts and their organizations.

10. As regards training methods, maintenance training should emphasise:

- Practical training in real conditions, or simulation;
- The importance of training for the management of maintenance;
- The value of preventive maintenance in order to reduce the need for repairs;
- Tutor-aided learning (as introduced by UNIDO).

Training for maintenance should take advantage of modern methods whenever suitable, both to help provide the increased volume of training which will be needed, and to cope with the demands of training for new technology.

11. Maintenance training requires specialized trainers at each level. Special importance should be accorded to supervisors, who frequently need to act as on-the-job instructors of junior staff. In this respect "Guided Transmission Training", as introduced in the ILO project in Ethiopia, can be a valuable model.

12. Evaluation of maintenance training must be carried out to monitor progress. This should be the responsiblity of the national maintenance training coordinating body, and should include:

- Testing and certification, to assure standards, enhance the status of maintenance workers, and help to reward them appropriately;
- Performance indicators should whenever possible be related to actual cash savings resulting form improved maintenance. The ILO's project in Ethiopia, the UNIDO project in Madagascar and other UNIDO training activities have shown that this approach is very acceptable to employers.

13. A number of African countries represented at the meeting have made good progress with some of the foregoing requirements for effective maintenance training, and it is highly desirable that information about these successful ventures be made available to other African countries, especially those in the same sub-region. Training for small industries and the informal sector has proved particularly difficult. Some countries have made a certain amount of progress, e.g. Cameroon, Kenya and Madagascar, and exchange of information about these efforts is highly desirable.

14. The provision of adequate finance for training for maintenance is a subject of concern. The possibility of a levy on industry for maintenance training appeared to command support, provided that the whole amount raised was used solely for this purpose. Cost of maintenance should be regarded as an investment rather than a drain. In this respect the ILO in its project in Ethiopia and UNIDO's project in Madagascar as well as other projects (bilateral and multilateral) have been able to present maintenance as a source of profit and potential saving.

15. Attention was drawn to the special importance of small and medium scale industry, and especially the informal sector. In general not enough industrial training support was given to small and medium-sized firms, and none at all to the informal sector. The latter is especially important, because:

- Informal sector workers provide many maintenance services, often of an unsatisfactory standard due to lack of knowledge and skill;
- In many African countries the informal sector constitutes the greatest part of national economic activity, and is therefore a very large potential resource including for improved maintenance - which is at present neglected.

Madagascar and Cameroon demonstrated the capability of assisting small industries to develop the manufacture of spare parts.

B. Recommendations

I. Policy recommendations to Governments and other concerned Institutions/Actors

1. National governments should adopt a national maintenance training policy, taking into account the points listed in Conclusion No. 7 above, and giving special attention to small and medium-size industry, and to the informal sector.

2. Each government should consider setting up a suitable national maintenance training coordinating body, if possible on a tripartite basis, representing government, employers and employees.

3. In relation to the levels of people to be trained (Conclusion No. 8), and who will carry out this training (Conclusion No. 9), the national maintenance training coordinating body should ensure that the national education and training systems can indeed provide all that is required, and that all the agencies concerned are aware of their responsibilities.

4. Regarding the national education system which has a vital part to play in training for maintenance, there should be a regular exchange of staff between university and industry; both to give students the benefit of being taught by actual practitioners from industry, and to give university staff the advantage of up-dating themselves technologically.

5. The national industrial training system must also make specific provision for training for maintenance. This requires that:

- Maintenance topics must be included in all training syllabuses, since there can be no industry without maintenance;
- Maintenance should be treated as worthy of recognition as a distinct and important occupation, at skilled worker level, at technician level, and at engineer level. There is much value in establishing and supporting a professional association of maintenance engineers.

II. International Cooperation

6. As set out in Conclusion No. 13 above, there should be exchange of information relating to training for industrial maintenance, in order to enable African countries to:

- Learn from each others' successes;
- Make use of each other facilities in suitable cases;
- Avoid wasteful duplication.

7. Technical cooperation between African countries should be encouraged and facilitated through:

- Study visits;
- Exchange of trainees;
- All other practicable activities in the field of training for industrial maintenance, such as cooperation between enterprises in different countries, both in the public and private sectors.

8. UNIDO should help to identify and to implement actions responding to paragraph Nos. 6 and 7 above.

III. UNIDO Technical Assistance

9. UNIDO should complete the analysis of the Papers prepared by the participants for the Nairobi meeting, in order to produce an annotated comparative study, drawing attention to significant similarities and differences, for the guidance of African countries and the Industrial Development Decade for Africa.

10. As the most effective method of initiating national action in support of training for industrial maintenance, UNIDO should assist in the promotion of maintenance training and training infrastructures in Africa, and should aim at assisting in the implementation of at least one project/pilot project in each country or sub-region. The pilot project would be a nucleus from which further action would flow, under the control and guidance of the national maintenance training coordinating body.

ISSUE C: NEGOTIATION AND ACQUISITION OF CAPITAL GOODS

A. Conclusions

1. The maintenance function does not start from the shop floor but indeed from the time of investment studies, project design, negotiation and acquisition of capital goods, project implementation, commissioning and operation. The stage of negotiation and acquisition of capital goods is of major importance in this process. The majority of African countries do not have properly trained negotiators to ensure that the maintenance function is well entrenched in contracts for the acquisition of capital goods.

2. African countries stand to benefit greatly from the exchange of experience in this sphere.

3. The role of UNIDO and the other UN organizations in training negotiators for the acquisition of capital goods in general and for ensuring that the maintenance function is well catered for in contracts is of primary importance in assisting African countries in their industrial development process.

I. Policy Recommendations to Governments and Other Concerned Institutions/Actors

1. Define a national strategy for negotiation and purchase of equipment as follows:

- Provide for the maintenance function at the pre-investment study stage;
- Include a maintenance services element (technical documentation, after-sales service, spare parts, training) in every equipment purchasing contract and provide for separate budgets;
- Select as plant desinger an engineering company with experience in similar countries.
- Open a dialogue between the user, purchaser and supplier;
- Involve maintenance specialists in early stage of the project;
- Provide separate terms of reference for technical documentation, spare parts and training;
- Set up the maintenance function at a sufficiently early stage during project implementation;
- Set up a unit to supervise the maintenance services provided by the supplier/builder.

II. UNIDO Technical Assistance

2. Organize an annual regional seminar for:

- Planning officers in the public authorities responsible for the purchase of equipment;
- Maintenance officers involved in the purchase of equipment or project implementation.

The seminar should deal with the following subjects:

- The maintenance function at the pre-investment study stage;
- The definition of a national equipment purchasing strategy;
- The formulation of specific terms of reference for the following services:
  - Technical documentation;
  - Spare parts;
  - Training of maintenance staff.

- The establishment of contractual clauses concerning:
  - The design of equipment with a view to its maintainability;
  - The legal aspects of the maintenance function;
  - After-sales service and technical assistance;
  - The choice of technology;
  - Comparative anaylsis of tenders;

  - Plant construction strategy;
  - Methodology for the supervision of a project and the maintenance services of the supplier
  - The standardization of equipment;
  - Preparation of the maintenance function during construction;
  - Determination of the share of the installations to be manufactured locally.

3. Promote a pilot rehabilitation or construction project for the practical application of the subject areas mentioned above through:

- Missions to identify a particular priority area in various countries;
- Use of the staff so trained in the implementation of the project.

4. Organize meetings of a regional working group (every year) to evaluate and exchange practical experiences in the above project and to improve, if need be, the programme of the regional seminar.

5. Assist developing countries in the preparation of equipment, purchasing contracts and in negotiations;

6. Define specifications in conformity with above-mentioned recommendations for the acquisition of capital goods under its care which are destined to aid programmes; apply these specifications within the various sections of UNIDO.

III. Cooperation between UNIDO and other Governmental and Non-Governmental Organizations

7. Invite other international institutions to adopt a common policy in the acquisition of capital goods.

8. Put at the disposal of Institutes of Higher Technical Formation all documents pertaining to pilot projects initiated by UNIDO and other UN agencies in some African countries concerning maintenance, training, manufacturing and management of spare parts etc.

ISSUE D: ORGANIZATION AND MAINTENANCE METHODS

A. Conclusions

1. Big enterprises (public and private) have maintenance departments in their organization charts, yet there is a lot to be done in the area of methods.

2. The problem is most serious in small and medium enterprises where in some instances maintenance units do not even exist. Even where they exist they are subordinated to production and therefore maintenance suffers.

3. During project preparation phase insufficient attention is given to the maintenance function which then does not feature properly in the project design, acquisition of equipment, plant construction, erection and operation.

4. The prevailing maintenance method is repair after breakdown.

5. Maintenance cost cannot be monitored because of lack of a data collection system and the inadequacy of the accounting system for that purpose.

6. The optimum amount of preventive and corrective maintenance to be performed should be based on cost data collected for the purpose.

7. Preventive maintenance can be facilitated with increased application of condition monitoring devices.

8. Computerization in maintenance management is good, but one has to work very hard in establishing a manual system beforehand.

9. During organization for maintenance one has to keep in mind the organization of facilities such as workshops and spare parts stores.

10. The nature of modern technology requires the need of multi-skilled maintenance crew (electrical, mechanical, pneumatic and electronic).

B. Recommendations

I. Policy Recommendations to Governments, other concerned Institutions/Actors

1. Create awareness of plant managers and production managers on the philosophy and importance of maintenance for production, and that maintenance is an investment and not a cost centre.

2. Establish data bank on maintenance parameters for inter-firm comparison, (maintenance costs, frequency of breakdowns, availability, etc).

3. Establish incentive systems for maintenance workers.

4. Consider granting facilities to support small industries providing maintenance and repair services, including the reduction of customs duties for equipment bought for maintenance workshops.

5. Encourage enterprises to develop techniques and methods of maintenance such as:

- diagnosis of faults and breakdowns;
- analyses of oils and greases;
- reclamation by metalization, thick electrolytic filling (chrome, nickel).

6. Promote the utilization of these methods through the elaboration of specific training methods.

7. Organize national and regional seminars to train personnel in the above-mentioned methods.

II. UNIDO Technical Assistance

8. Prepare module maintenance manuals for trainers of maintenance management.

9. Promote regional cooperation by creating means of spreading existing experience in maintenance management to other African countries such as that of the Ethiopian Management Institute (developed with the assistance of ILO) and other similar institutions such as those in Morocco, Cameroon and Madagascar.

ISSUE E: SPARE PARTS

A. Conclusions

1. There is potential for local spare parts manufacture in a number of African countries and manufacturer of small and simple spare parts is already taking place. The scope for manufacture of high precision spare parts and spare parts requiring higher technology of manufacture is low.

2. Certain spare parts being locally manufactured are of lower quality mainly because of poor alternative raw materials being used, low manufacturing skills, lack of requisite tooling, lack of metallurgical and physical analysis facilities and also because spare parts are being manufactured without use of engineering drawings at shop floor level. In a number of cases detailed manufacturing drawings for imported equipment are not asked for or are not supplied.

3. Spare parts locally produced are usually more expensive than imported spares mainly because of problems of economies of scale. Most spares are produced as single units instead of series production and this mode of production results in higher costs of production and hence higher prices. There is also generally some delay in meeting customer demands. All the same, entry into local manufacture of spare parts assists in raising equipment production availability and it creates a good basis for entry into capital goods industry.

4. Some degree of reconditioning or reclamation of spare parts, particularly heavy spare parts, is being done through welding and re-machining. Even in this area there is the problem of quality because of know-how and proper materials and equipment for reconditioning.

5. Lack of standardization of imported equipment for similar application makes entry into series production of spare parts even more difficult. Diversification of range of motor vehicle spare parts that can be locally manufactured is difficult in many countries because of the large number of motor vehicle types and models being imported by African countries.

6. Lack of local capabilities to design and redesign spare parts is a serious constraint in African countries.

7. There is wrong and unnecessary ordering of spare parts. For new projects spare parts that should be initially supplied are normally determined by the supplier of equipment or plant - local recipient industries do not determine quantities of spare parts that should be supplied with equipment because quite often they do not know the design of equipment being supplied.

C. There is deficiency in spare parts management skills in such areas as codification of spare parts, stock control, preservation of spare parts and keeping of spare parts consumption data.

B. RECOMMENDATIONS

I. Policy Recommendations to Govenments, other concerned Institutions/Actors

1. Establish or strengthen local expertise to identify spare parts which can be locally manufactured by use of facilities and skills available in industry. Systems of sub-contracting among industries and mechanical workshops in spare parts manufacture should be encouraged.

2. Develop or strengthen local capabilities in design and redesign of spare parts and their manufacture.

3. Establish and/or strengthen spare parts reclamation practices because this is cheaper than spare parts manufacture. Reconditioning of heavy and larger spare parts for which manufacturing facilities may not be available should be given priority.

4. Establish basic spare parts manufacturing facilities such as machine shops, foundries and forge shops. Tool Rooms for manufacture of critical and high precision spare parts and tools should be established. Metallurgical and chemical analysis facilities should be established and quality control personnel should be trained.

5. Establish incentive schemes that will stimulate more interest in spare parts manufacture, reconditioning and reclamation. Such incentives could include priority allocation of foreign exchange for raw materials importation to industries or workshops engaged in spare parts manufacture, and reduced tariff rates for equipment being imported for spare parts manufacture.

6. Institute, where considered appropriate, government regulatory controls that will bar user industries and other importers from importing spare parts which can be locally manufactured. Governments should obtain expert advice on the list of spare parts that can be locally manufactured at economical levels.

7. Develop skills and expertise to be able to choose spare parts and quantities which should be ordered taking into consideration technical and financial aspects, and to consider existing storage facilities and spare parts preservation.

8. To establish spare parts departments or sections under maintenance departments so that the spare parts departments can be closer and therefore more responsive to spare parts needs for equipment maintenance. This arrangement also assists in raising technical skills of personnel involved in purchasing and storing spare parts.

II. International Cooperation

9. Promote the exchange of information and experiences through National Engineering Design Centres or similar institutions and through ARCEDEM.

III. UNIDO Technical Assistance

10. Provide technical and financial assistance to National Engineering Design Centres where they already exist and assist countries which would like to establish similar centres and in the training of technical personnel.

11. Provide technical and financial assistance to strengthen the capacities and capabilities of developing countries in the manufacture, repair, and reclamation of spare parts, in particular those of electro-mechanic workshops.

12. Provide technical and financial assistance in conducting regional and sub-regional training programmes in spare parts management.

ISSUE F: TECHNICAL DOCUMENTATION

A. Conclusions

1. Technical documentation is one of the most important factors in a maintenance management system.

2. There are no complete technical documentations available to maintenance personnel.

3. Most of maintenance personnel are not at the level of using technical documentation.

4. There is lack of technical offices and personnel for preparing technical specifications for maintenance work.

5. Sometimes equipment is delivered without complete technical documentation due to lack of specification at the time of ordering.

B. Recommendations

I. Policy Recommendations to Governents, other concerned Institutions/Actors

1. Complete technical documentation must be requested and clearly specified while elaborating tender documents. This must be catered for in the contract.

2. Establishment of technical offices in medium and big enterprises for smooth operations of maintenance.

3. Updating of technical documentation to reflect changes due to new technologies.

4 Update technical documentation according to any alterations during erection, start-up, and all life of equipment.

5. Install a centralized technical documentation section covering all aspects.

6. Ensure that personnel are sent to suppliers for preparation of machine files and technical documentation prior to supply of plant.

II. UNIDO Technical Assistance

7. Prepare guidelines and training programmes for human resources development to deal with the above recommendations.

8. Promote exchange of information about technical documentation between African countries.

I. ORGANIZATION OF THE MEETING

1. The Regional Expert Group Meeting on Human Resources Development in Industrial Maintenance in Africa, was held in Nairobi, Kenya, 23 to 27 June 1986. The Meeting was attended by a total of 30 participants, comprising 13 experts from 13 African countries, 6 experts and 4 observers from developed countries, two African Regional Organizations (ARCEDEM and IHTTR), one Labour Organization (COTU - Kenya) and 4 United Nations Organizations (ILO, UNESCO, UNDP, UNIDO).

Confer:

Annex No. 1 - List of Participants
Annex No. 2 - Programme of the Meeting
Annex No. 3 - List of documents for the Meeting.

Opening of the Meeting

2. The Meeting was opened by Mr. J. M. Scoular of the Overseas Development Administration of the United Nations and Commonwealth Department of the United Kingdom; in his capacity as Representative of his Government. In his opening address, Mr. Scoular stressed the importance that his government attaches to human resources development in the industrial development process of developing countries and to industrial maintenance, especially in Africa, to avoid the rapid deterioration of industrial capital assets on which industrialization depends. He showed his Government's support for the System of Consultations as a unique forum for international cooperation in the industrial field. He stated that human resources development is a major factor for self-sustaining industrial growth in developing countries. Hence his Government's interest in sponsoring the meeting.

3. Mr. G. L. Pennacchio, UNDP Resident Representative in Kenya, in a statement read on his behalf by Mrs. A. L. Josiah, paid tribute to UNIDO and to the System of Consultations for organizing the meeting and for creating the right environment for international cooperation and identification of technical assistance projects - the field in which UNDP is primarily involved. He emphasized the importance of industrial maintenance in Africa and the training of maintenance personnel. He made reference to the UNDP

sponsored meeting on "Post-Investment" held in Rabat, Morocco in May 1985 where the concept of "Post-Investment" was launched. He defined "Post-Investment" as the sum of activities aiming at the highest profitability of invested capital in terms of volume and quality of yield, together with the longest possible life of equipment installed by such investment. He also referred to the North-South Roundtable on "Development: The Human Dimension" (Istanbul, Turkey, September 1985) where it was demonstrated that one of the major obstacles to economic progress in developing countries is the inadequate attention given to the development of human resources.

4. In a statement made by a Representative of the UNIDO Secretariat a warm welcome was given to the participants for accepting UNIDO's invitation to attend the meeting. The meeting formed an ideal group that could make concerted efforts to search for solutions to problems and constraints faced by developing countries in their industrialization process, particularly in overcoming their ever-present problem of industrial maintenance in order to safeguard the patrimony of their capital goods, equipment and infrastructures, and to optimize on their utilization. He pointed out that it is estimated that the life-span of machinery in Africa is only 70% of that elsewhere, and that capacity utilization due to lack of or poor maintenance in many African countries is only 25% to 50%. Apart from losses of billions of dollars due to pre-term substitution of machinery, production breakdowns, loss of orders, etc, untold unquatifiable losses are sustained due to the obstruction of the industrial and economic development process, not to mention the detrimental effects in the social sphere arising from de-motivation and frustration of the labour force. He thanked the African participants who had prepared national case studies which were of very high quality and constituted important inputs for the deliberations of the meeting.

II. SUMMARY OF DISCUSSIONS

5. Short introductory presentations were made by UNIDO staff members. A staff member from the System of Consultations, dealt with the importance of the meeting in the context of the overall preparations for the Second Consultation on the Training of Industrial Manpower which is envisaged for September 1987 in Paris, France. He referred to the recommendations of the

Meeting held in Paris, France in January 1986, explained the objectives of the Nairobi meeting, and emphasized the need for action-oriented conclusions and recommendations.

6. Another UNIDO staff member from the DIO/TRAIN, presented the training activities of UNIDO in the area of industrial maintenance[11/] which included courses, seminars and workshops, as well as activities aimed at strengthening industrial training institutions including those dealing with maintenance and repair. He referred to a UNIDO sponsored project with the Union of African Railways concerning maintenance and repair of railway equipment, and institution-building activities for industrial training in maintenance in Egypt, Zimbabwe and Madagascar.

7. Finally, one representative of the Unit for the United Nations Industrial Development Decade for Africa (IDDA), reminded participants that the eighties had been declared as the Industrial Development Decade for Africa by the UN General Conference (Resolution 35/66 B). One of the major priorities for industrial development envisaged by IDDA and the Lagos Plan of Action was human resources development. This was reconfirmed by the Fourth General Conference of UNIDO in August 1984. He appealed to participants to bring forward their individual experiences and identify needs in human resources development in industrial maintenance which may give rise to appropriate technical assistance projects in furtherance of the objectives of IDDA.

8. Mr. De Groote, UNIDO Consultant, stated that the poor functioning of many industries in developing countries originates, in the majority of cases, from the lack of maintenance of the production equipment. The principal causes can be put into the following five groups: acquisition, design and use of production equipment; organization and management of maintenance; material resources for maintenance (technical documentation, spare parts, financial means, tools and measuring instruments, maintenance equipment); human resources, social economic and cultural environment of developing countries. All these factors are interdependant. Their origins can be found in

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11/ Confer: "UNIDO's Training Activities in the Area of Industrial Maintenance" No. V. 86-52210, Industrial Training, UNIDO.

insufficiencies or lack of arrangements at different levels of operators and decision making centres: the investment planner, the designer of plants and machinery, the customer and equipment supplier, the company and its production units, the government as well as organisations for financing and development aid. Remedial actions must be cohesive and must cover all maintenance problems in general in various economic sectors as well as on differnt levels. Because of the interdependance of the factors that occur in the problem of maintenance and the relationship of cause and effect between these factors, little purpose would be served in improving one without the other. An overall approach is therefore necessary. A maintenance policy should be determined at a national level, as well as at the level of organisations for financing and development aid. This policy must lead to an implementation strategy which will define a plan of action for the levels mentioned above. The maintenance policy must rest upon a pragmatic approach and must form a link between diverse operational levels in such a way that the implementation does not become impossible. Human resources development should automatically be part of this maintenance policy at each level and the proposals should be accompanied by appropriate measures for the development of the necessary capabilities. He suggested the selection of a target industrial sector, the concentration of maintenance organization and methods in one or two plants, and once results are quantified, diffusion of the results to other plants and sectors through a continuous sensitization campaign addressed at decision-makers, workers and the population at large.

9. Mr. C. Pichot, UNIDO consultant, stressed the economic aspects of maintenance, and that money spent on maintenance has to be looked upon as an investment rather than a cost. Many decision makers in government and industry were not yet sensitized on the benefits of maintenance, giving rise to parks of abandoned machinery, machinery exploited beyond the limits of safety where quantity of production was the only criterion, unlocatable spare parts, replacement of machinery instead of maintenance and repair, improvised repairs and cannibalization of machine parts. All this leads to "economic penalties" through rapid aging of plant, low capacity of utilization, low and poor production and continued hard currency purchases of unrealised

production goods. He stressed the importance of organizing maintenance on a sound footing in the key economic sectors through the identification of a pilot plant in each sector and country, which would be a model for other sectors and firms to emulate.

10. Mr. I. Domaski, ILO Representative, pointed out that maintenance programmes must be result-oriented, where results can be quantified in terms of data on lower breakdowns, improved production, lower cost of inputs and overall financial gain. This is in line with UNIDO's result-oreinted training system. In order to cope with the extent of the problem, it was important to embark on training of "transmitters" - trainers who are also working . One consultant can train a number of "transmitters" and in turn these "transmitters" train their crew on the job. He was appreciatve of ILO-UNIDO collaboration in industrial training.

11. Mr. O. Ibukun, UNESCO Representative, spoke of the important role of educational short and long term policies as basis for further industrial training by specialized institutes and in-service training in industry. He called for better coordination between formal education and the private industrial sector in order to limit the mis-match between educational preparation and the needs of industry. He also referred to UNESCO's programmes in the field of control and maintenance of scientific equipment e.g: hospital equipment, which includes the setting up of a network of instrumentation centres in Africa. His presence at the meeting showed the close cooperation between UNESCO and UNIDO.

12. All participants made note-worthy contributions to discussions drawing on the national case studies they had prepared.

13. Most participants underlined the importance of having a "national maintenance body" which would carry out a sensitization campaign, organize training activities, ensure coordination between formal education and industrial training for maintenance, and prepare a national strategy for maintenance.

14. Finance was singled out as a major factor in the implementation of any

maintenance strategy at national or enterprise levels. The view was however expressed that once the financial benefits of maintenance became well known, the necessary financial and human resources would be made available. Hence the importance of starting maintenanct sensitization campaigns through the publicity of results obtained in selected pilot plants.

15. All participants agreed that maintenance should be receognized as a distinct profession and that associations of maintenance engineers should be encouraged. Maintenance engineers and personnel should be rewarded for their contribution to production and development by granting them comparable status with traditional professions. Employees should facilitate the training of their employees in maintenance by allowing them to attend in-service training courses. They should also develop career development opportunities for maintenance personnel.

16. Information played a crucial part in the maintenance strategy. Information systems must be set up within plants to collect the necessary data about maintenance based on cost inputs and gains resulting from proper maintenance. Such information must be fed back to planners and decision-makers in the plant and should be exchanged with similar firms in the sector. Exchange of similar information should be done on sub-regional and regional levels.

17. There should be an integrated approach to maintenance. The maintenance function must be given importance from the time of the project concept, investment studies, preparation of tender documents and contracts for acquisition of plant, plant design, erection, commissioning and operation. Training must be organized for different categories of personnel involved in project planning, implementation and operation.

18. Computerized maintenance systems are beneficial to enterprises with extensive and complex plant and equipment. Attention must however be paid to computer programming which should be tailor-made for the requirements of the enterprise. Appropriate training must be given to personnel handling the computer and other personnel who must utilize computer instructions and collect data to be fed into the computer.

Three presentations were made by industrialists. Two of these dealt with computerized maintenance systems and one with a UNIDO sponsored technical assistance project concerning training of personnel in the maintenance of railway equipment.

CLOSURE OF THE MEETING

Upon completion of the work-programme and adoption of the conclusion and recommendations, a Representative of the UNIDO Secretariat thanked the participants for the hard work they had put in, including evening work, to bring the meeting to a successful conclusion. He stated that the meeting had achieved its objectives of coming out with concrete and action-oriented conclusions and recommendations which could serve as basis for a programme of activities for the Second Consultation on the Training of Industrial Manpower, as a guide for action for developing countries, as modalities for international cooperation and as basis for the generation of technical assistance projects. He thanked all those who had contributed for the success of the meeting.

ANNEX I

REGIONAL MEETING OF EXPERTS ON THE DEVELOPMENT OF HUMAN RESOURCES FOR INDUSTRIAL MAINTENANCE IN AFRICA

23 - 27 JUNE 1986

PREPARATORY TO THE SECOND CONSULTATION ON THE TRAINING OF INDUSTRAIL MANPOWER

LIST OF PARTICIPANTS

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II. UNITED NATIONS AND OTHER ORGANIZATIONS

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UNITED KINGDOM

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ANNEX II

PROGRAMME OF THE MEETING

Monday 23 June:

09.30 - 10.30	Registration of participants
10.30 - 11.00	Official opening by Mr. J. M. SCOULAR, Representative of the Government of the United Kingdom. Introduction to the meeting by the UNIDO Secretariat
11.30 - 13.00	General presentation of the issues by the UNIDO representatives and consultants.
14.30 - 16.00	Issue A: National strategy for maintenance
16.30 - 18.00	Continuation and conclusion of discussions

Tuesday 24 June:

09.30 - 11.00	Issue B: Training policy for maintenance
11.30 - 13.00	Continuation and conclusion of discussions
14.30 - 16.00	Issue C: Negotiation and acquisition of capital goods
16.30 -18.00	Provisional conclusions and recommendations on issues A, B, and C.

Wednesday 25 June:

09.30 - 11.00	Issue D: Maintenance organization and methods
11.30 - 13.00	Continuation and conclusion of discussions.
14.00 - 19.00	Visit to Training Institute of Kenya, Power and Lighting Co, Nairobi, and Training Institute and Factory of Kenya Canners Ltd, Thika.

Thursday 26 June:

09.30 - 11.00	Issue E: Spare parts (local manufacture)
11.30 - 13.00	Issue E: Spare parts (management)
14.30 - 16.00	Issue F: Technical documentation
16.30 - 18.00	Draft conclusions and recommendations on issues D, E and F.

Friday 27 June:

09.30 - 11.00	Finalization of conclusions and recommendations on issues A, B and C.
11.30 - 13.00	Finalization of conclusions and recommendations on issues D, E and F.
14.30 - 16.30	Discussion and adoption of conclusions and recommendations of the meeting.
	Closure of the meeting.

ANNEX_III_

LIST_OF_DOCUMENTS_FOR_THE_MEETING

Mr. De GROOTE	Guide for Action in the Field of Human Resources Development for Industrial Maintenance in African Countries.
Mr. C. PICHOT	Investment in Maintenance: Economic Stakes and Possible Strategies.
Mr. M. CROFTON	The Role of Human Resources Development for Industrial Maintenance.
Ms. I. LORENZO	UNIDO's Training Activities in the area of Industrial Maintenance No.V.86-52210, Industrial Training, UNIDO.

NATIONAL_CASE_STUDIES

BURUNDI	M. F. RWAYOYA	"Etude Prèparatoire à la Réunion Régionale d'un Groupe d'Experts sur le Développement des Ressources Humaines pour la Maintenance Industrielle".
CAMEROUN	M. J. M ETOUNDI	"Etude concernant le Cameroun sur le Développement des Ressources Humaines pour la Maintenance Industrielle en Afrique".
COTE_D'IVOIRE	M. M. EKRA	"Profil de la Côte d'Ivoire concernant le Développement des Ressources Humaines pour la Maintenance Industrielle en Afrique".
EGYPT	Mr. D. TANTAWI	"Case Study for Steel Industry in Egypt."
ETHIOPIA	Mr. Y. TECLE	"National Case Study (Ethiopia) on Human Resource Development for Industrial Maintenance".
KENYA	Mr. S. M. ITA	"A National Case Study Paper on Human Resources Development for Industrial Maintenance."
MADAGASCAR	M. J. ANDRIAMASOLO	"Etude de Cas: Quelques aspects sur le Développement des Ressources Humaines dans le Cadre d'un Programme de Maintenance Industrielle à Madagascar".

MAURITIUS	Ms. D. WONG	"Human Resources Development for Industrial Maintenance in Mauritius".
MOROCCO	Mr. M. BACHIRI	"Post-Investissement et Maintenance au Maroc".
SENEGAL	Mr. H. GUISSE	"La Mise en Valeur des Ressources Humaines pour la Maintenance Industrielle en Afrique - Le Cas du Sénégal".
TANZANIA	Mr. G. MSOLLA	"Human Resources Development in Industrial Maintenance: the Case of Tanzania".
ZAIRE	M. C. I. WUT'IYELA	"Etude de Cas concernant le Zaire sur le Développement des Ressources Humaines pour la Maintenance Industrielle en Afrique".