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Workshop on Maintenance Management
in the Industrial Sector*

Conakry (Guinea)
15-17 October 1991

REPORT**

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* Organized by UNIDO in cooperation with the Pilot Centre for Industrial Technology (CPTI).

** This document has been translated from an unedited original.

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INTRODUCTION

The observed phenomenon of the very rapid deterioration of acquired appropriate technology, including modern equipment and technical systems, has impeded the industrialization of the developing countries. This phenomenon can be seen at all levels, and especially in the following sectors and subsectors: industry, transport and communications, water supply and drainage, production and distribution of electricity, cement, steel, the food industry, agricultural equipment, fertilizers, etc. The facts show that Governments have not been able to find adequate ways of checking this process in their countries. As a result, at the macroeconomic level, the rate of return on investment is not only lower than it should be, but will very soon fall to zero.

In some developing countries, a 30-per-cent reduction in the life of equipment due to lack of maintenance is one of the inevitable consequences. This situation leads to additional costs, lower production, unrealized profits and loss of markets, for all of which it is impossible even to estimate a figure. In other countries, one can find graveyards of abandoned machines and equipment, machines operated beyond the limits of safety and endurance, spare parts gone astray, orders being placed for new equipment rather than for the repair or maintenance of that which already exists, and the import of goods that should have been manufactured using defective equipment.

Against this background, the Second Consultation on the Training of Industrial Manpower, held in Paris in September 1987, unanimously recommended that technical visits and workshops should be organized in order to encourage exchanges of experience as part of national and international support for training in maintenance management at the enterprise level.

It was with this in mind that the Workshop that is the subject of this report was held from 15 to 17 October 1991 in Conakry (Guinea) at the invitation of the authorities of that country. The main objectives of the Workshop were:

- To provide industry, other sectors of the economy, and African Governments with information on the role of maintenance as one of the key factors to be considered in company management;

- To stimulate and heighten awareness, at the decision-making level in various developing countries and companies, of the importance and substance of maintenance policies, in particular by quantifying the obvious benefits;

- To provide an opportunity for diagnosing the problems in industrial maintenance management encountered in developing countries, and for proposing solutions to these problems;

- To examine opportunities for regional and international cooperation, with particular reference to human resource development in relation to maintenance activities.

I. ORGANIZATION OF THE MEETING

Opening of the meeting

1. The Workshop on Maintenance Management in the Industrial Sector, held in Conakry (Guinea) from 15 to 17 October 1991, was opened by the Secretary of State for Energy, His Excellency Mr. Toumani Sako. In his opening address, he welcomed the participants and spoke of the poor performance of industrial enterprises due to lack of adequate management, including the area of maintenance. In his view, maintenance should form an integral part of overall management in any industrial activity and a piecemeal approach should as far as possible be avoided. He was grateful, therefore, to the United Nations Industrial Development Organization (UNIDO) for taking the initiative in organizing this Workshop in his country on a topical subject of particular importance to all African countries.

2. In his address to the meeting, the Director of the UNIDO System of Consultations expressed his gratitude to the Guinean Government for its hospitality and to the participants for agreeing to take part in an event to which UNIDO attached the greatest importance. He pointed out that the Workshop had been organized by the UNIDO System of Consultations Division to encourage an exchange of experience between the participants and, above all, to stimulate an awareness of the importance of maintenance as a tool for increasing the profitability of industrial enterprises. In that connection, he recalled the two main objectives of the maintenance function: firstly, to keep equipment operational and reliable throughout its service life and, secondly, to optimize the utilization of equipment in maintaining uninterrupted production. Thus, he went on, it was essential, both nationally and within enterprises, to adopt a clearly defined maintenance policy to which decision makers and workers would be genuinely committed. Such a policy should aim at achieving measurable results, notably increased production and returns.

Election of the bureau

3. Mr. Souleymane Condé, Head of the Standardization Section of the Guinean Ministry of Industry, Trade and Crafts (MICA), was elected president of the meeting. Mr. Jean-Martin Etoundi, President of the Cameroon Association of Maintenance Engineers, was elected rapporteur.

Adoption of the programme

4. The programme adopted is contained in annex II.

II. PRESENTATION OF THE WORKING PAPER AND DISCUSSIONS

A. Common problems of maintenance management in industry

5. The UNIDO consultant outlined the common critical factors affecting maintenance management in industrial plants in both developed and developing countries. He noted that:

The factory and its operation were the source of many maintenance problems, especially at the pre-investment stage, long before the start of production. He drew the attention of the participants to such important aspects as the adaptation of equipment to local conditions, the availability of technical operating and maintenance documentation, the timely supply and installation of machines and spare parts, personnel training, technical assistance for start-up, and, above all, after-sales service.

Maintenance organization and management were at the root of a number of hitches in factories. The speaker emphasized the pressing need to establish a clear, well-defined organizational chart, with detailed job descriptions, for the maintenance function. He also underscored the importance of certain frequently neglected aspects, in particular methods, scheduling, preparation of work, start-up, maintenance management and inventory control. Lastly, he urged the need for coordination between the maintenance and production departments.

The material resources required for maintenance operations were technical documentation, spare parts, tools, test and measuring instruments, machine tools and workshop equipment. Of these, the discussion leader placed special emphasis on technical documentation and spare parts.

He said that studies carried out in several countries showed that only about 5 per cent of factories surveyed had complete documentation; 15 per cent had sufficient documentation to carry out adequate maintenance; 55 per cent had incomplete documentation, often written in a language other than that used at the factory; and 25 per cent had no documentation whatsoever. Underscoring the failure of supplier and customer alike to pay sufficient attention to the question of technical documentation, he observed that that documentation had to be a priority consideration if it was hoped to achieve an effective transfer of technology.

Spare parts were a major source of concern to heads of enterprises. As an example, he pointed out that 50 per cent of all production stoppages in developing countries were due to lack of spare parts. This situation was mainly linked to the following causes: (a) a wide diversity of equipment suppliers; (b) a frequently poor choice of spare parts in stock, due to inadequate information in the technical documentation supplied by the manufacturer and also to lack of experience in plant operation on the part of those responsible for selecting the parts; (c) incorrect spare part designations; (d) no coding of spare parts within the plant owing to the absence of an internal coding system, improper labelling of parts and, above all, poor use of the coding grid where one existed; (e) a lack of foreign exchange for the import of spare parts, leading to a running down of factory stocks, and in particular a haphazard allocation of import quotas in some countries; (f) a lack of adequate facilities for storing, handling and preserving parts (cleaning, protection, and anti-shock or anti-corrosion surface coatings); and lastly (g) no use of inventory analysis (Pareto method), resulting in the continued stocking of parts for machines no longer in use.

6. The problem of local spare part manufacture was also raised. The absence of domestic plants and production capacity inhibited the local manufacture of these items. Moreover, the industrial environment within which factories operated in developing countries was very limited for profitable investment in that field.

- Human resources. Given the undervaluing of the maintenance function at industrial plants, especially in Africa, inadequate maintenance training was one of the major obstacles to factory operation. It was, therefore, a matter of clearly identifying training needs and methods (centres, schools, institutes, etc.) and of making use of training methods that were not too far removed from the everyday practical experience of maintenance technicians and engineers. On-the-job training was also to be encouraged.

- Financial constraints. The discussion leader drew attention to the meagre budgetary resources allocated for maintenance at those plants where there were such budgets at all. He also referred to the lack of hard currency, which very often prevented orders from being placed to ensure an adequate resupply of the spare parts needed to keep machines running and to ensure uninterrupted production.

7. On this subject, the consultant observed that it was by highlighting the maintenance function and taking account of its various facets that one could help to solve the crucial problem of maintenance in many industries. He pointed out that a maintenance strategy aimed at improving maintenance practices, providing rigorous and thorough training, and supplying complete and intelligible documentation were essential factors in ensuring the full utilization and longevity of the means of production. He also noted that an industrial project was no longer simply a matter of supplying equipment and services. It was much more than that. Above all, it was an integrated process in which production, operation and maintenance should play a major role from the start.

8. The participant from Cameroon observed that in seeking solutions to maintenance problems in Africa, a distinction should be drawn between the problems attributable to the designers of machines and equipment and those of the users. He suggested that priority should be given to solving users' problems. African countries, for example, had no choice in the equipment they received. Accordingly, it was necessary to analyse and implement methods for their maintenance, namely, standardization and local manufacture of essential spare parts and adaptation of equipment to the full range of conditions encountered. He recommended that data-processing should be introduced into maintenance management, and emphasized the need for a change in attitudes.

9. This same speaker also proposed that, in order to make top decision makers conscious of the maintenance function in African industries, it was up to the people involved in maintenance first to identify their needs and then to present their grievances to the decision makers.

10. The participant from Kenya acknowledged that maintenance was a necessity and that there was reason to promote the concept of total asset management and publicize it. He said that the maintenance function should be discussed at the highest level. The image of maintenance professionals needed to be enhanced and cultivated. He added that the establishment of associations of maintenance engineers in African countries should be encouraged.

11. Expressing appreciation of the collaboration of the French-speaking participants, the participant from Kenya proposed that local production units to manufacture spare parts should be set up. He also spoke of the need for regional cooperation.

12. The participant from Zimbabwe stated that increased production and the profitability of industrial facilities should be a matter of concern to all Governments, especially in Africa. He said that statistics showed that proper maintenance practices would lead to a considerable increase in production and profitablity.

13. He went on to say that decision makers in Government, particularly those with a voice in the purchase of new equipment and the establishment of new industrial facilities, should be aware of the fact that maintenance was no longer simply a matter of repairing machines that had broken down. The right kind of maintenance required good organization and tight planning.

14. He stressed the critical importance of involving from the outset the maintenance manager in project preparation, since this person would be in a position to draw attention to obstacles and hindrances to proper maintenance procedures before the plant went into operation. He said that, given the importance of the maintenance function in the industrial sector, Governments should be asked to legislate in this area. In other words, no large-scale project not supported by a recognized national institution of maintenance engineers should be approved.

15. The participant from Sierra Leone noted that the evident need to accept maintenance should not be seen as a burden for top management but rather as a productive organizational tool through which productivity could be increased at least cost and, as a result, profits maximized. Accordingly, the role of maintenance in any organization needed to be regarded as an art, a science and a service whose main objective was to ensure that the plant or equipment was reliable, maintainable and operational, which was often not the case. However, in their efforts to fulfil this task most developing countries were faced with constraints that affected the maintenance function. These included lack of qualified personnel, lack of machines and equipment suitable for making spare parts, lack of tools for quality control of these spare parts, lack of adequate and appropriate materials for manufacturing spare parts, and others.

16. He accepted, of course, that not all these constraints would likely be present at the same time in the same country, but the conjunction at a given moment of one, two or three of them could, in his experience, interfere with the maintenance function and hinder a factory's production for quite a long time.

B. Economic aspects of maintenance

17. The discussion leader spoke of the importance of the maintenance function at the micro- and macroeconomic levels. He described, with the aid of examples and statistical tables, the scale of expenditure that an enterprise or a country had to accept in order to ensure at least an acceptable level of maintenance for its manufacturing plant. The presentation laid stress on cost analysis at enterprise level, in particular on costs incurred during the operating cycle and during breakdowns.

18. One of the participants from Tunisia expressed his conviction that the maintenance problem today presented African countries with a dual challenge, one that confronted industrial enterprises, indeed the whole infrastructure of these countries, with a dramatic choice: either enterprises with no future or salvation through a genuine leap in awareness in order to save what was still

salvageable of national heritages built up at great cost and sacrifice. This dual challenge was both a source of hope and a grave concern. As he saw it, the specialist literature, field surveys and incontrovertible evidence observed in African countries confirmed the scale of the financial, technical and technological dimensions of the maintenance problem. Given the large amounts of money directly lost by enterprises as if by evaporation as a result of non-existent or improper maintenance, maintenance constituted an inexhaustible mine for African countries. This was true not only for the enterprises directly concerned, but also for complete chains of workshop operators, study bureaux, technicians and workers. Thus, not only could maintenance be a source of profit for those providing and mastering these services, but it could also generate quantifiable employment and value added as well as the, for these countries, non-measurable assets of know-how and technological expertise.

C. What maintenance really is

19. The discussion leader noted that the maintenance function had long been considered a secondary function in many industries, and that this attitude had resulted in considerable financial losses. It had been relegated to the role of a mere breakdown and repair service for worn and obsolescent equipment.

20. He defined the object of the maintenance function as ensuring maximum utilization of manufacturing plant and infrastructure and other related means of production at minimum cost and in a manner consistent with good quality, safety and environmental protection.

21. He spoke of the different forms of maintenance, namely, conceptual maintenance (enhanced operation, reliability or capacity of the equipment), preventive maintenance (regular scheduled servicing of equipment to detect faults and correct them), conditional maintenance (a technique of breakdown prevention without dismantling, based on audio-scans of the equipment concerned) and, lastly, corrective maintenance (breakdown servicing and repairing of machines). He pointed to the correlation between sound maintenance procedure and equipment performance as part of an integrated managerial strategy, and concluded by describing the routine activities of a maintenance service and the various levels of the maintenance function.

22. The participant from Tunisia who had spoken previously reopened the discussion by forcefully reaffirming his conviction that the industrialization process initiated by the newly independent Governments had, firstly, been introduced as a kind of magic wand for transforming African companies from a state of backwardness to one of modernity and development and, secondly, that the industrialization undertaken had been imitative in its approach, grafted *in toto* onto those countries and their companies, so that the essential requirement under this process assimilation and absorption had never been met.

23. He went on to say that one of the effects of this process had been a deterioration in industrial manufacturing plant, with the maintenance function, where it existed at all, reduced to simple breakdown servicing and repair, replacement, and the scrapping pure and simple of whole sections of some industrial facilities. He suggested that it was imperative to approach the question of maintenance from the angle of technology assimilation and absorption, and not as a kind of imitative and superficial technical exercise. The way to achieve this was through a range of complementary measures to be undertaken by the educational system and through vocational

training that systematically and over the short term inculcated an understanding of maintenance as it applied to public and individually owned assets that would become a way of life.

24. He suggested that the authorities should provide incentives to encourage enterprises to introduce the maintenance function in a systematic way. That applied equally to companies, boardrooms and maintenance services. Non-governmental associations should be created by maintenance technicians and engineers to consider how best to implement maintenance strategies. Concerned international organizations should continue to work to develop exchanges of personnel and experience among African countries at all levels and especially at the levels of macro and micro-economic decision-making.

25. He then introduced his company, Tunisie Engineering Construction Electro-mécanique (TECEM), and outlined its main objectives. The firm's principal areas were mechanical engineering, assistance in that field, and inter-enterprise subcontracting. TECEM was also involved in the design and installation of maintenance systems for industry, maintenance assessment, and industrial maintenance training. Its main clients were the cement producers and the Tunisian National Railway Company (SNCFT), its subcontracting operations being with small and medium-sized enterprises and the engineering workshops of large national concerns.

26. The Tunisian participant concluded by inviting those present who wished to learn more about his company to get in touch with it with a view to arranging exchanges of experience and cooperation.

27. Following this speaker, the participant from Cameroon briefed the Workshop on the Cameroon Association of Maintenance Engineers. This association had organized meetings, factory visits, conferences and training events (seminars) in Cameroon. In particular, it had taken action to heighten awareness of the importance of the maintenance function in the country's manufacturing industry. The speaker also described this new association's project for the immediate future. This project essentially involved the creation of a database covering maintenance in Cameroon and pursued very precise objectives: to identify the requirements for specialist personnel and industrial maintenance engineers; to identify needs for staff training and prepare appropriate industrial maintenance training programmes; and, finally, to recruit young graduates who wished to set up maintenance workshops. This initiative by maintenance engineers and technicians in Cameroon was to contribute to making available the kind of skilled human resources necessary to Cameroon's industrial development and to promote the efforts undertaken within the framework of the master plan for the industrialization of the country.

28. The general discussion that followed these two presentations dealt for the most part with training and the need to heighten the awareness among African Governments of the importance of the maintenance function as it applied to industrial plant and other infrastructural assets.

29. After describing their day-to-day maintenance activities and the problems they faced, several participants spoke of the need to provide basic and advanced training for maintenance staff within enterprises in order that the countries concerned might make effective use of their material and financial resources. There was also a need to step up the exchange of experience among African countries, with specific regard to the qualifications of maintenance managers, planners and workers.

30. On the question of maintenance policies, participants pointed to the need to make managers aware of the advantages and importance of maintenance. Moreover, the right kind of language had to be found so as to convince both politicians and senior civil servants of this inescapable requirement by proving to them that maintenance, in addition to allowing savings in scarce foreign exchange, would permit increased production, sales and profits.

31. Many participants welcomed the initiatives and measures taken by UNIDO and the International Labour Organisation in the area of maintenance training in African countries. They called upon these two international organizations to persist in their efforts and assist interested African countries in establishing national associations of maintenance engineers.

D. Maintenance planning and operations

32. The consultant noted that this activity should be considered as part of an enterprise's overall management strategy. Among other things, the hierarchical status of the maintenance department within the organization should be raised, for example, by placing it at the same level as the production department. The maintenance manager should be a member of the enterprise management committee. The presentation included a list of maintenance strategy areas, emphasizing that each area should be the subject of an enterprise master plan (see document listed in annex III).

33. The participant from Ghana observed that a key element in maintenance planning and operations was the availability of the financial resources and skilled personnel with which to establish a functional maintenance system at enterprise and even national level. The system had to be functional in the sense that its tangible and intangible results should be apparent to and appreciated by the whole enterprise (with performance indicators reflecting a direct increase in productivity).

34. In his view, the necessary training should be provided at both the local and regional levels and should be linked to a systematic follow-up procedure in order to measure the impact of this training in improving the maintenance function at different enterprises.

35. He went on to say that the low level of production capacity utilization in most African industries, particularly State industries, clearly demonstrated that maintenance had not been accorded the priority importance it deserved in all areas of industrial activity. Where statistics were lacking, he recommended that any information available on the way maintenance functions were performed in different types of industry in Africa should be used in their place. On this basis, it would be possible to formulate plans and programmes by providing the necessary inputs and, after that, to monitor improvements in maintenance practices. These statistics could be classified as follows:

(a) Multinational enterprises (operating in the country);

(b) Parastatal enterprises;

(c) Private enterprises;

(d) Small enterprises.

36. He also said that the level of participation in the Workshop made it clear that Governments and/or representatives of African industries were indeed concerned. It would be interesting to know the depth and extent of Government interest and the degree to which managing directors were prepared to analyse their maintenance budgets. If the various ministers of industry could assess the commitment to maintenance at enterprise level, UNIDO could then design programmes aimed at arousing a genuine awareness of this subject among decision makers.

37. Several speakers raised the question of data processing in maintenance management. For many of them, given the relative unfamiliarity with the concept of the maintenance function itself in many African countries, the introduction of data processing as a maintenance management tool seemed premature. Other speakers, however, expressed the view that nowadays data processing was an essential need and that sooner or later it would have to be brought into maintenance management. In any case, the starting point remained proper and adequate training in maintenance for the industrial sector.

III. RESULTS AND CONCLUSIONS

General

38. The participants recognized the usefulness of the Workshop in promoting horizontal exchanges of information and experience and in increasing the awarenesss of the importance of maintenance in African countries. They agreed that the Workshop and the contacts between participants were useful tools in the search for solutions to maintenance management problems in the industrial sector.

39. The participants from Guinea asked UNIDO to consider organizing a national workshop on specific subjects. The participants from the English-speaking countries represented also asked UNIDO to organize a similar worksnop in their area.

40. Several participants requested UNIDO to publish the results of this Workshop in order to inform decision makers at the macro and micro-economic levels so that they could formulate maintenance policies for their countries and enterprises, respectively.

41. Many participants referred to the need to take account of the real needs and concerns of African countries in contracts aimed at the transfer of technology.

Changing attitudes

42. All the participants underscored the fact that it was important and necessary to change the way the maintenance function was perceived in industry. So far, they said, maintenance had, in most cases, been regarded as the case-by-case servicing and repair of malfunctioning equipment in order to prevent production stoppages. The Workshop had helped make participants realize that maintenance management was much more a matter of a comprehensive system involving all divisions of an enterprise.

43. The participants recognized that Governments, industrial circles and enterprise managers had to be made aware of the problem so as to encourage them to formulate and implement permanent maintenance policies or systems. That implied the establishment of an administrative structure, the release of the necessary credits, the acquisition of maintenance equipment, and the provision of personnel training at all levels and in all areas of maintenance activity.

Training in industrial maintenance management

44. All the participants stressed the point that priority should be given to training in maintenance management. They agreed that it was a matter of urgency not only to provide practical training for maintenance engineers, but also to promote the training of trainers in order to gradually establish a reservoir of African expertise in this field. To that end, there was a need to increase the number of meetings, support and assist vocational schools and, if necessary, establish one or two maintenance schools in Africa so as to avoid having to establish one in each country.

Local production of spare parts

45. The common problems in maintenance management in Africa derive essentially from the lack of locally available spare parts and difficulties encountered in securing a reliable supply of these parts from abroad. In order to reduce this foreign dependence, the participants were in agreement that one of the solutions would be to explore opportunities for creating small units for local manufacture of simple spare parts before gradually tackling the manufacture of more and more complex components.

Follow-up

46. UNIDO, in cooperation with the ILO, Governments and interested local institutions, was requested to:

(a) Publish the results of the Workshop in order to encourage African Governments and industrialists to formulate maintenance policies at the national and enterprise levels in their countries;

(b) Organize a national workshop on maintenance management in Guinea with the principal aim of establishing a Guinean association of maintenance engineers;

(c) Organize a similar workshop in East Africa for the English-speaking countries;

(d) Promote maintenance activities, linking them to the establishment of small industries for the local manufacture of spare parts; develop and/or strengthen standardization and quality-control activities for spare parts so as to make them more easily interchangeable;

(e) Encourage the training of trainers in industrial maintenance management.

Annex I

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Annex II

PROGRAMME

Tuesday, 15 October 1991

10.00 to 11.30	1. Registration
	2. Presentation followed by discussion on "Common problems of maintenance management in industry"
13.00 to 15.30	3. Official opening of the Workshop
	- Address by the Government representative
	- Introductory statement by the UNIDO representative
16.00 to 18.00	4. Election of the bureau and adoption of the agenda
	5. Presentation followed by discussion on "Economic aspects of maintenance"

Wedenesday, 16 October 1991

9.00 to 10.30	6. Presentation followed by discussion on "What maintenance really is"
11.00 to 12.30	7. Discussion continued
13.30 to 15.00	8. Presentation followed by discussion on "Maintenance planning and operations"
15.30 to 16.30	9. Discussion continued

Thursday, 17 October 1991

9.00 to 10.30	10. Conclusions and recommendations
11.00 to 11.30	11. Suggestions for follow-up to the Workshop
11.30 to 12.00	12. Official closing of the Workshop

Annex III

INFORMATION PAPER

Maintenance management IPCT.142 (SPEC.)