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HUMAN RESOURCES DEVELOPMENT FOR EFFECTIVE MAINTENANCE
AT ENTERPRISE LEVEL*

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HUMAN RESOURCES DEVELOPMENT
FOR EFFECTIVE MAINTENANCE AT ENTERPRISE LEVEL

INTRODUCTION

1. The lack of adequate maintenance is costing the developing countries several billions of US dollars every year by way of reduced life-span of equipment alone. It is an unfortunate fact of life that existing generally-accepted accounting practices do not tell the enterprise manager the effect that inadequate maintenance is having, and will continue to have, on his operating accounts. His accountants can tell him how much profit or loss he made last year, but they cannot tell how much greater profit (or smaller loss) he would have made if his equipment had broken down less often or if a smaller proportion of his production had to be scrapped or reworked, nor that a plant which could have served profitably for many years is going to have to be scrapped very much earlier. They cannot prove to him, in short, that he would do better by allocating more resources and paying more attention to maintenance.

2. Yet there is ample proof that good maintenance pays for itself, and pays handsomely. It is not always a mathematical proof, buttressed by numbers, but rather an estimate based on experience. It is simply that no successful enterprises neglect maintenance. They take very good care of their physical assets. A spirit of maintenance, a maintenance culture, is a large component of the "corporate culture" of successful enterprises. Conversely, enterprises which neglect maintenance are not successful. When one sees factory buildings where broken windows are left unrepaired, or trucks on the road with rust-streaked paintwork, it does not require deep perception to appreciate that the enterprises concerned are headed for trouble. A fundamental issue addressed in this paper is, how can a spirit of maintenance, a maintenance culture, be acquired by enterprises which at present lack it? Other issues consider policies and actions that may be necessary for the installation of systematic maintenance systems and the training of personnel in all aspects of maintenance in the enterprise.

POLICY FOR ORGANISATION AND METHODS OF MAINTENANCE AT THE ENTERPRISE LEVEL

3. In most enterprises in developing countries, industrial maintenance is not given the importance it deserves. This lack of attention to maintenance has a detrimental effect on the conservation of the patrimony of capital assets of the enterprise and its industrial output. It has been estimated that the life-span of equipment in many developing countries is reduced by about 30% for lack of proper maintenance^{1/}. Moreover, in more than 300 maintenance audits in different developing countries, it was found that the average technical availability of industrial equipment stood at only 32%. Problems connected with maintenance were, in 80% of the cases, the cause for the unavailability of equipment^{2/}.

4. In the majority of cases this very poor performance is the consequence of the lack of explicit, clearly formulated, and fully implemented maintenance policies at the enterprise level. In their stead are unclear implicit policies, according to which it is vaguely understood that it is the task of maintenance to repair breakdowns and generally keep the machines operating. The problem is that these implicit policies lead to operating difficulties. Because they do not clearly define authority and responsibility, nobody knows precisely what is to be done, when, and by whom; whenever maintenance problems arise the operations staff blame the maintenance staff, and vice versa. Thus maintenance policies must be explicit, written policies which clearly detail where authority and responsibility for maintenance are assigned by nominating personnel who would be permanently in charge of maintenance. Also, these policies must be implemented; the finest policy documents are totally useless if they are just shoved in a desk drawer and forgotten.

^{1/} "Training for Industrial Maintenance Work in Developing Countries", J. Perrin, UNIDO/IPCT.13, page 3.

^{2/} "Industrial Maintenance in Developing Countries", P. De Groot, page 2, (Paper presented at Preparatory Meeting for the Second Consultation on the Training of Industrial Manpower, Paris, France, 13-17 January 1986).

5. Maintenance policies, if they are to be effective, must be soundly based on good practical considerations. Many enterprises have elaborate maintenance policy documents that are ignored because they do not work in practice. A recurring problem is that top-level managers (those at the policy-making level) have difficulty in distinguishing between maintenance management and maintenance activities. The shop-floor activities of lubrication, machine repair, periodic overhaul, etc., are taken to constitute the whole of the maintenance function, so that the supervisor in charge of the maintenance crew is considered to be the maintenance manager, while in fact the real management decisions about what maintenance activities should be carried out, and when, are made elsewhere. For example, in oil refineries the common practice when a plant is to be overhauled, is for the plant operations manager to specify in detail the maintenance work to be done and to inspect the work after the maintenance crew has finished. In contrast, in sugar mills the major maintenance work is done between crushing seasons and is actually done by the operations personnel according to a programme developed by the factory manager or chief engineer. Clearly, policies that ignore these "facts of life" are likely to be ignored. A danger here is that the written policies might distort the real situation in order to obtain a neat and orderly organisation chart.

6. Maintenance does not stop at the shop-floor activities. Almost every industrial plant undergoes greater or lesser degrees of modification during its life, to correct faults in the original design, to improve various aspects of its operation (including maintainability), and to incorporate new technological up-dating. Usually these modifications are entrusted to the maintenance personnel, either to execute directly or to supervise the work of outside contractors. Enterprise policies must cover these situations, making clear where responsibilities lie for initiating modification proposals, engineering design, costing, execution, etc.

7. At a still more sophisticated level it is important that in all stages of the selection and acquisition of capital goods, particularly those including technologies new to the enterprise, considerations of the maintainability and maintenance needs of the proposed acquisitions be taken fully into account. Here again enterprise policies must make provisions to ensure that the maintenance department is fully consulted at all stages of this process.

8. The maintenance function does not exist in isolation, but rather in the context of the enterprise as a whole. While the enterprise looks to the maintenance function to keep its productive plant and equipment in good operating order, the maintenance function must be able to call on the rest of the enterprise for the support and resources needed for this task. Enterprise policies must reflect this. They should cover, for example, financial policies controlling access to fixed capital for machine tools and measuring equipment and to working capital for stocking spare parts, personnel policies which allow the recruitment and retention of suitably-qualified people, and training policies which ensure continuing up-grading of maintenance skills.

9. Policies have to be translated into working practices if they are to be effective. A key stage in this is to decide upon the organisation of the maintenance function. Various forms of organisation are found. Some enterprises use a fully-centralised maintenance department, with skilled mechanics going out to service the operating units as required, while others prefer a decentralised structure, with each operating unit having its own complement of maintenance personnel, while yet others use a combination of the two. Similarly, the operating maintenance budget might be centralised in a maintenance department or decentralised under the control of the operations units. Spare parts inventory control might be assigned to Administration, Maintenance, Operations or Procurement. Technical documentation could be the responsibility of Engineering, Operations, or Maintenance. Each enterprise will use the structure which, in its view, best suits its own particular circumstances.

10. Like all functions in the enterprise the maintenance function must be managed, and good management depends critically on good information systems. The maintenance department should have an internal system covering such things as machine inspection reports and work orders from other departments, which are needed for day-to-day management and which can be used to develop machine histories and spare parts consumption forecasts. Also needed is a system of reporting maintenance performance, covering such items as production lost through shutdowns (both scheduled and unscheduled), loss of production through maintenance-related quality problems, and similar data. These can be used to monitor performance, to show year-by-year improvements or deteriorations, and for comparison with accepted standard figures for the industry.

11. A good number of enterprises already have in place a cost-accounting system which reports the cost of the maintenance function. Unfortunately, there are no generally-accepted accounting procedures for estimating the benefits derived from good maintenance. Such accounting, emphasizing costs and ignoring benefits, can lead to ill-advised pressure to cut costs by reducing resources allocated to maintenance. Enterprises should develop their own systems for estimating the benefits of improved maintenance (for example, estimates of incremental revenues for each additional hour of availability of key or bottleneck machines) as a tool for preparing maintenance budgets on a rational basis. Information obtained through inter-firm comparisons and/or through participation in professional associations will also be useful in this.

12. Much useful information can be obtained from professional journals and attendance at professional meetings. This sort of information covers, amongst other matters, such things as representative figures for maintenance costs, manning levels for maintenance departments, personnel training practices, and new maintenance techniques. Enterprise maintenance policies should consider encouraging senior maintenance personnel to join professional associations and enabling them to attend professional meetings, which might be of national, sub-regional, regional or inter-regional scope. Arrangements might also be made for interchanging maintenance personnel for suitable periods of time with other enterprises, in the same country or other countries, as a means of widening their experience.

13. Developing and implementing effective maintenance policies is a complex matter. It will often be necessary to recruit an experienced maintenance specialist at a senior management level to take charge of this process. It may also be necessary to seek assistance from outside the enterprise, from consultants or training institutions. Although the actual operation of a well-organised maintenance system is not particularly difficult, setting up such a system can be very complex, involving setting up new documentation and procedures, re-organising spare parts procurement and inventory control, training and re-training mechanics and operators, and negotiating and arranging new procedures and relationships between the maintenance department

and other departments, all more or less simultaneously. Very few enterprises can make available the management, technical and training resources to do all this by themselves. Nevertheless, if the enterprise is to be able to continue operating the new system it is essential that all its managers and other concerned personnel be closely and actively involved in the implementation process.

14. Several different models of programmes for implementing the maintenance improvement process have been used successfully in recent years in developing countries. These models lay emphasis on obtaining top management commitment to the programme, on the need for enterprise-wide sensitisation and training, on the full involvement of enterprise personnel in the implementation process (with continuing support from consultants throughout the whole implementation cycle if necessary), on attention to the motivation of those whose work patterns will be affected by the changes, as well as on the "shop-floor" aspects of maintenance. They also stress the importance of measuring in monetary terms the benefits obtained at each stage of the implementation. This acts as a powerful motivator to all concerned and ensures the continuing interest and attention of top management. In this way they act to promote a maintenance culture in the enterprise and not merely a technical maintenance capability. Enterprises might consider taking actions, individually or collectively through trade and/or sectoral associations or other organisations, to arrange presentations and seminars on these models to evaluate their applicability to enterprise needs and to develop ways and means by which they can be made available.

TRAINING IN MAINTENANCE AT ENTERPRISE LEVEL

15. Maintenance training, in its widest sense, comprises all the training that is needed for the full implementation of the maintenance policies of the enterprise. It is thus an enterprise-wide activity. In some cases it may be little more than sensitisation to the importance and the requirements of the maintenance function. Thus, marketing and sales personnel would only need to appreciate how plant overhaul programmes affect stocks of finished goods in order to avoid promising their customers unrealistic delivery dates, while

accounting and financial personnel would need rather more training so that effective financial control can be exercised over maintenance budgets and expenditures without hampering the maintenance function by arbitrary, ill-informed decisions. Production staff would need training in how to operate a production plant without abusing it, how to detect incipient trouble in the equipment, how to liaise with the maintenance department, etc.

16. Training for maintenance personnel should be a carefully programmed long-term concern, which should take into account the following special characteristics of maintenance work:

- (a) In almost all enterprises plant and equipment is specialised to some degree, so that newly-recruited maintenance personnel, even those with previous work experience, need corresponding training or retraining.
- (b) Graduates of vocational training institutes and apprenticeship schemes are invariably specialists such as fitters, welders, electricians, etc. Most maintenance workers, however, must have some knowledge of other trades besides their own original speciality. For example, when a mechanic makes a routine inspection of a centrifugal pump he must report not only on the pump itself but also on its associated piping and fittings, its electric drive motor, and the motor's switching and control gear. Learning the basic theory and practice of these other trades requires a programme of training extending over a considerable time.
- (c) Many operators feel that newly-qualified apprentices and graduates of vocational training institutions, however competent they might be technically, do not have sufficient specialized knowledge and practice to be entrusted with the care of expensive equipment. These qualities should not be allowed to develop by chance but should be nurtured by programmes of personal and skills development.
- (d) The continuing arrival on the industrial scene of new technologies (for example, electronic control gear) and new materials (for example, industrial ceramics and industrial adhesives) creates a need for a corresponding up-grading and up-dating of skills of maintenance personnel. This career-long training is essential in maintenance work.

17. All this training is in-service training, of people already employed. It may be done in the enterprise and/or in outside training institutions. It may use both formal classroom methods and informal on-the-job methods. Whatever combination of training sources and methods is used, the training programme must be consciously managed by the enterprise, preferably by a competent trainer working in collaboration with the maintenance manager. It should as far as possible match career development of the individuals concerned with the overall skills portfolio required by the maintenance department.

18. Training in maintenance may however have to deal with new or improved technology or equipment where it may not be possible to carry it out within the enterprise or the country. In this case, trainees may have to be trained abroad, either in the country of origin of the equipment, or in countries where such technologies already exist, perhaps in nearby developing countries at a lower cost.

19. An integral part of a training policy, of course, would ensure that trainees are given incentives and rewards. Successful trainees in maintenance must look forward to the recognition of their calling and to career development in the same way as employees in other more traditional callings do. Women are able to carry out a number of jobs in a maintenance system, and they should be given equal opportunity for training and for career development.

20. It is important that for new projects, or new installations of internal services or machinery, the maintenance personnel are attached very closely to the contractors/suppliers who are undertaking construction, erection and commissioning works. This is certainly one of the best ways of on-the-job training, which solves many a problem later on in diagnosing faults in plants, machinery, equipment and in internal services, and in rectifying such problems.

21. An enterprise training policy in maintenance must also be formulated with respect to negotiation and acquisition of capital goods, technical documentation and the management and manufacture of spare parts. These aspects will be treated in the sections that follow.

NEGOTIATIONS AND ACQUISITION OF CAPITAL GOODS

22. As already emphasised, the maintenance function starts with the concept and planning of a project, investment studies, and the negotiation and acquisition of capital goods.

23. In these early stages of project development, great attention must be paid to the choice of technology, which should have been tested and proved successful elsewhere, and which should also be within the maintenance capability and capacity of the enterprise and the country. The design of equipment is of extreme importance, not only from its maintainability aspect but also bearing in mind that it may have to be adapted to suit climatic and other conditions in users' countries. It should be seen to that as far as possible equipment and components are standardized, in order to facilitate maintenance and to reduce the variety and cost of spare parts to be kept in stock. With regard to the initial list of spare parts to be supplied with new equipment, careful selection must be made to ensure that only essential spares are included, according to their rate of consumption, and that slow-moving stock is avoided.

24. Developing countries are at a disadvantage in all this, since often they do not have the experience to define their requirements and to draw up detailed technical specifications. They have, more or less, to rely on the advice of the supplier, who may not be the same as the machine constructor. Again, project planners may not be in a position to estimate the investment cost in maintenance in the preparation of investment studies. In such cases it might be desirable for enterprises to make use of consultancy services to assist their personnel since the work is not of a recurrent nature. It might be desirable to include a maintenance specialist in the team that negotiates the acquisition of equipment.

25. The above indicates important areas for action within enterprises, probably with the support of national or sectoral institutions, namely the development of human capacities for project development in general and for maintenance activities in particular. These include:

- (a) The selection of appropriate and maintainable technologies vis-a-vis the human and physical environment and conditions;
- (b) The preparation of realistic feasibility studies;
- (c) The development of effective working relations between plant designers, constructors, suppliers and users;
- (d) The training of negotiators.

26. In the actual negotiation of contractual arrangements for the acquisition of equipment one should ensure the inclusion of suitable clauses, or subsidiary agreements to the principal agreement, on the following aspects:

- detailed specification of plant, machinery and equipment, showing capacity and scheduled down-time;
- standardization of equipment, sub-assemblies and components, as far as possible;
- provision of adequate and detailed technical documentation;
- continuity of availability of spare parts under suitable price arrangements;
- continuity of after-sales service and competent technical support in the operation and maintenance of equipment;
- supervision by user of construction, installation of internal services, machine installation and commissioning where users' maintenance personnel have to be involved from the outset;

- detailed lists and specifications of initial supply of spare parts and consumable stores and their individual rates of consumption;
- adequate provision for training of personnel at all levels and functions, with emphasis on maintenance personnel (training of maintenance personnel may be desirable before installation starts);
- the construction and equipping of maintenance workshops and spare parts stores on priority basis in order to provide for adequate "services" during the installation of equipment and for pre-training of maintenance personnel;
- manufacturing drawings for selected spare parts subject to wear.

27. It has to be borne in mind that most of the above items cost money to provide, and it may be counter-productive for negotiators from developing countries to try to squeeze too much out of suppliers during negotiations. If this happens, the supply of certain essential items or services, especially training, is bound to be below expectations. Hence the importance of dealing only with reputable and proven suppliers, and of obtaining objective and independent advice from professional consultants or international organisations if need be.

TECHNICAL DOCUMENTATION

28. Technical documentation is an essential instrument in the organisation of a maintenance management system. Without it, it would be extremely difficult to effect preventive and corrective maintenance, quick trouble shooting and repairs, and dismantling and re-mounting of equipment, as well as carrying out correct choice and administration of spare parts, the repair, reclamation, reproduction or manufacture of spare parts and the effective training of maintenance personnel.

29. Yet technical documentation is frequently not given sufficient importance. Often it is left to the supplier of equipment to deliver as much of it as he likes. It should be stressed that detailed technical documentation is expensive. Therefore, if it is not properly budgeted for, and just left to the machine supplier, only the barest, and perhaps useless, documentation will be supplied. Indeed, there have been cases where machines were supplied, and accepted, without any documentation at all.

30. Technical documentation must be well catered for in the terms of reference, the detailed specifications of the tender documents and the contract for the acquisition of the equipment. It must be supplied in a manner and language which is well understood by the user. Preferably it should arrive before the equipment itself in order to prepare for the physical work and installation of internal services required for the erection of the machinery in order to train the erection and maintenance crews. It must be checked on arrival just as any other physical item supplied, since it might be realised, too late, that the necessary documentation is not to hand.

31. It would be desirable to centralize the keeping of documentation in order to ensure that technical documentation is well preserved, codified and classified. Documentation should be up-dated in accordance with changes due to new developments in the technology or variations during erection and operation of the equipment. Copies of original documentation may then be distributed to the relevant users within the enterprise as necessary.

32. In view of the importance of technical documentation, enterprises should ensure that in their training policies and programmes they include the training of personnel in the preparation of terms of reference and specifications for technical documentation to be included in tender bids for equipment, in the building up of documentation files for the more important machines which may cause bottle-necks in production, in the interpretation of documentation and technical drawings and in the reproduction of technical documentation where for some reason or other none exists.

MANAGEMENT AND MANUFACTURE OF SPARE PARTS

33. Many of the problems of poor maintenance in developing countries stem from the unavailability of the right spare parts because of the lack of allocation of foreign exchange for imports or administrative delays connected with the issue of import licences and other permits. In some cases this blame might be justified, but often the problem of spare parts may be placed at the door of the enterprise management. Many enterprises face problems connected with spare parts because these were either badly stored and could not be located, or were erroneously ordered so the wrong spares were sent, or were badly packed for long term storage and could not be utilised when they were most needed, or simply because inadequate allowance was made for delivery lead-time.

34. A stock administration system starts with the criteria for the ordering of the right spares depending on the rate of wear and tear and the frequency of change of moving parts. Minimum and maximum stock levels have to be established for every stock item. Re-ordering points have to be fixed depending on delivery times and administrative delays. On receipt, goods have to be checked thoroughly to see that they conform with orders, part numbers, quality and condition. Designation, codification and proper stacking ensure quick retrieval of parts if urgently needed. Goods must be well preserved in the store (greasing, putting in plastic bags, etc.). Clearly, a stock administration system involves paper work - cards to show average periodic consumption, landed price, delivery time from time of ordering, mini-maxi stock levels, re-ordering points; bin cards to record physical receipt and issues from store; receipt and issue chits, etc. Computerized inventory control may be considered worth-while, especially since the price of both hardware and software is decreasing.

35. In the proper implementation of stock administration there is a linkage with aspects covered in other sections of the paper. For example, ordering, classification and codification of spare parts can only be done if adequate and detailed technical documentation is available. The volume of spares to be stored can be reduced substantially if, at the stage of project planning and acquisition of capital goods, thought is given to standardization of equipment and components. The right spares in the right volume can only be ordered if the maintenance specialists have been involved in calculating the frequency of change of moving parts. Parts can be well stocked in the store if attention to this is given in construction plans concerning size, location and equipment for the store (shelves, pallets, fork-lifters, etc.). And all this can only be done if the finance manager has allocated the necessary funds for the acquisition of the physical assets and the adequate training of personnel.

36. Many enterprises have ventured, with different measures of success, into the repair, reconditioning and even the complete reproduction or manufacture of spares. Great importance should be attached to repair and reclamation of parts since it can be less costly than ordering new parts and simpler to carry out than outright reproduction or manufacture. Modern methods of welding, metallization, electrolytic filling and re-machining, have often proved useful and economic in many developing countries.

37. The repair and reconditioning of spare parts, as well as the full reproduction of parts, require specialised skills and special materials not always available within a single enterprise. Inter-company cooperation may therefore reap benefits. Individual enterprises may specialise in repairs, reconditioning and reproduction of parts on an industrial sub-sectoral basis, e.g. repair and reconditioning of parts of ferrous as against non-ferrous metals; cast, forged or machined parts; instrumentation repair; etc. It would be desirable if enterprises, through their associations, would make known to each other what facilities or capabilities they dispose of and the services they can render in this field to fellow manufacturers.

38. Before manufacture of spare parts is undertaken, it may be advisable to carry out detailed studies to identify the items to be manufactured economically at least on batch production basis. Other pre-conditions include the availability of skills, requisite machine and cutting tools, technical information (workshop drawings, specification of materials, knowledge of tolerances); industrial infrastructure such as foundry, forge, heat treatment, instruments for accurate measurements, metallurgical and physical analysis; and the possibility of procurement of the materials of the right specification (special steels, chemicals). Quality control is essential, since a part which is not perfect in shape or condition may cause damage to the equipment.

39. Small-scale enterprises may prove to be well-adapted to the repair, reclamation and manufacture of spare parts because of their small size and flexibility, depending mostly on small production runs or even on one-off jobs, and their capability in switching production from one item to another. Small-scale units may therefore be sub-contracted by larger ones in these areas.

SPECIAL PROBLEMS AND NEEDS OF SMALL- AND MEDIUM-SCALE ENTERPRISES

40. Small- and medium-scale enterprises (SMEs) face special problems with respect to maintenance. These arise from the fact that, almost by definition, most of these enterprises do not have, indeed cannot afford, specialised maintenance personnel. In many cases maintenance problems are not serious during the first few years after the business starts because entrepreneurs usually choose activities they already know, and so can service and repair their equipment themselves. The danger comes when the business expands or new equipment acquisitions incorporate new technology. The entrepreneurs may not know the new technology and cannot afford time to be trained themselves, and have no one they can send for training. Another danger is that lacking negotiating resources of large-scale enterprises, they may acquire equipment without ensuring adequate technical support and guarantees of spare parts availability from the suppliers.

41. Bodies such as employers' and trade associations and chambers of commerce can be of assistance to the SMEs in several ways. They can organise presentations on new technologies and round-tables at which users of new technologies can share their experiences. They can develop standard forms of contract covering technical back-up and spare parts supply for use by small-scale entrepreneurs in negotiating machinery acquisitions. They could also arrange for suitable training institutions to provide courses for personnel of groups of SMEs; such courses would be too expensive for individual SMEs, but could be offered at acceptable prices on a group basis.

42. Small-scale entrepreneurs typically have virtually emotional ties with their enterprises and are thus pre-disposed to have a positive attitude towards maintenance. However, because their enterprises are small, numerous and widely dispersed, it is difficult to provide them with maintenance-related training and technical assistance through conventional channels. Nevertheless, in view of their importance as contributors to GNP and creators of employment and their key role as suppliers to other, larger enterprises, serious attempts should be made to develop non-conventional channels for these services. A possible channel is for large-scale enterprises to make training and technical assistance available to their SME sub-contractors. Maintenance for SME's by mobile maintenance units might also be organized by enterprises or institutions which cater for SME's.

DEVELOPING AND MAINTAINING A HIGH MAINTENANCE CULTURE IN THE ENTERPRISE

43. A maintenance culture, a spirit of maintenance, is part of the corporate culture of every successful enterprise. Thus it permeates the entire business. Section 2 of this paper discusses the matter of suitable training and sensitisation for all personnel of the enterprise, so that they could all co-operate with and contribute to the maintenance function. A maintenance culture, however, is more than just the skills and knowledge produced by training. It is also an attitude, a state of mind, a definite positive desire to keep everything in the work-place in top condition.

44. Such an attitude cannot be decreed by management order: it can only be nurtured by management. For this a favourable environment is necessary. Management at all levels must have a commitment to good maintenance and this commitment must be known to everyone in the enterprise. The organisation of the maintenance function must be known by everyone, in the sense that anyone wanting to report a problem knows how and to whom it should be reported, and the operation of the maintenance function must be efficient so that people reporting problems can see action being taken on the reports within a reasonable time, otherwise they will become frustrated and cease reporting. And it is vital that suitable recognition be given to people who demonstrate a positive maintenance spirit.

45. Enterprises can learn much about promoting a maintenance culture by studying how successful enterprises go about this task. Ways of doing this can include visits by senior management to successful enterprises and arranging for representatives of such enterprises to lead seminars and workshops on the subject. Competent management and maintenance consultants and specialized Agencies such as UNIDO and ILO are other sources of advice.

46. At the collective level, employers' and trade associations and similar bodies can set up maintenance promotion units in the same way as many have already set up productivity improvement units, or expand the latter to incorporate a maintenance promotion section. These units would provide, inter alia, a forum where members can compare experiences and exchange ideas.

47. A constant problem in many developing countries is the poor level of, equipment and building maintenance in vocational and other training institutions. Clearly, young people graduating from such institutions will tend not to bring a spirit of maintenance with them into their subsequent employment, and will have to be re-trained. Enterprises can take action, again at the collective level, to improve this situation. Pressure can be put on the relevant government agencies to make adequate resources available for the proper upkeep of plant and equipment in such institutions, and enterprises can make the services of competent maintenance managers and supervisors available to these institutions to help them improve their maintenance activities.

POINTS FOR DISCUSSION

48. Discussions during the Second Consultation may focus on the following points:

(i) Policy for organisation and methods of maintenance at the enterprise level

An enterprise policy for effective maintenance essentially deals with the sensitization of all levels of personnel to the benefits of a systematic maintenance system, and the establishment of suitable organisation and methods to implement it. What position should the maintenance department have in the organisation chart of the enterprise? What are the key elements of a maintenance system? What categories and qualifications of personnel are required to implement it? If such personnel are not available within the firm, re-training or recruitment of experienced personnel may have to be considered. What support do enterprises in developing countries require from national, regional or international sources to assist them in formulating suitable maintenance policies, and in organising a systematic maintenance system?

(ii) Training in maintenance at enterprise level

In-service training has an essential role to play in developing human resources in industrial maintenance. What form should in-service training take for different sizes of enterprises and for the various categories of personnel in the different industrial sub-sectors? How can enterprises help each other in this sphere?

Guidelines for organising training in industrial maintenance are available from various sources. Are firms aware of the existence of such guidelines? Are firms aware of the institutions which can provide training in maintenance in the country and outside it?

Maintenance personnel have a right to equal treatment, incentives and rewards, and career development comparable with their counterparts in more traditional professions and trades. How can maintenance personnel take their rightful place among traditional professions and trades?

(iii) Negotiations and acquisition of capital goods

Human resources have to be developed to avoid mistakes at the stage of negotiation and acquisition of capital goods, since such mistakes may bring serious problems in production and maintenance later on. What action can enterprises take to develop human resources in this field? What support do they need from national and international sources? Since negotiation and acquisition of equipment is not a day-to-day management function, should enterprises rely on their own resources, or should they engage professional consultants or international organisations to assist them on an ad hoc basis?

(iv) Technical documentation

The importance of technical documentation is often under-estimated in its role as a management tool to effect preventive and corrective maintenance; ordering, repair, reproduction and manufacture of spare parts; and fault diagnosis in equipment and installations of utilities. Technical documentation must therefore feature prominently in contractual arrangements and budgetary estimates. How much of technical documentation is necessary for the smooth establishment and operation of a project? How much should it cost in relation to total investment cost? What form of training is necessary to develop human capabilities for the acquisition of appropriate technical documentation, and for its interpretation, reproduction, conservation and up-dating?

(v) Management and manufacture of spare parts

The proper functioning of the spare parts store is a sine-qua-non in the maintenance system. An inventory control system including the paper work connected with it has to be installed to ensure recording of receipts, movements and accountability for spare parts. It must ensure the minimum investment in stocks while at the same time ensure the availability and quick retrieval of parts when required. Computerized inventory management may be more accessible to firms since the costs of hardware and software are progressively decreasing. What support do enterprises need to install suitable inventory management systems? What training is necessary for personnel to implement such systems? How can it be carried out?

The importation of spare parts is costly and time consuming. Many spare parts may be repaired, reclaimed, reproduced on a one-off basis, or even manufactured on batch production basis. This calls for full and detailed workshop drawings, technical specifications, adequate know-how, availability of special tools and materials, and appropriate manufacturing facilities. Specialised skills have to be developed first for repair and reclamation of spare parts and then for reproduction or outright manufacture. What are the constraints facing enterprises in undertaking these activities? What measures can be taken to overcome such constraints?

(vi) Special problems and needs of small- and medium-scale enterprises

Because of their large numbers and limited financial resources it is impractical to provide training and technical assistance directly to individual small- and medium-scale enterprises (SMEs). Such assistance can only be supplied cost-effectively on a group basis. This implies that it must be supplied through, or with the involvement of the Government, membership organizations, (trade association, employers' association, chamber of commerce, etc.). How can these associations be made aware of the importance of providing such assistance? How can the associations themselves be helped to organise programmes of assistance of this type for their members?

It is observed that in general only a relatively small proportion of SMEs are actually members of their respective associations. What can be done to improve membership rates and thus make the associations more effective as conduits for training and technical assistance?

(vii) Developing and maintaining a high-maintenance culture in the enterprise

Introducing a maintenance culture in an enterprise which lacks one can be a prolonged and complex undertaking, particularly in societies which do not value maintenance. What sources of assistance are available in developing countries to help in this? Would it be useful to develop detailed case studies of enterprises that had succeeded in introducing such a culture? What would be the best way of making use of such studies?

Employers' associations and similar bodies can play an important role. Are there any examples of good models of this type which could be made more widely known and copied? What are the best ways of mobilising the prestige and resources of these organisations in promoting a maintenance culture?

The promotion of a maintenance culture within the enterprise and in society as a whole are mutually reinforcing activities. Conversely, generating a maintenance culture at the enterprise level is much more difficult in a society that sets a low value on maintenance. How can enterprises, individually and collectively, most effectively influence and support government-level policies and programmes to heighten the appreciation of maintenance outside the industrial sector? Should schools and educational and training institutions be priority targets for such activities?