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Euro-Arab Workshop on Computerized
Maintenance Management Systems
(DU/RAB/89/022)

3-2

Prague, Czechoslovakia, 12-16 February 1990

REPORT*

* Mention of company names and commercial products does not imply the endorsement of UNIDO.

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I. Background information

Recent years are hallmarked by the wide-spread use of personal computers (PC) for managerial tasks in industrial enterprises regardless their size and production scope. One important part of managerial tasks is related to maintenance management, specifically the maintenance of capital goods, fixed assets, production equipment etc. The importance of good enterprise management and proper maintenance management of capital goods is stressed by the fact, being proved in many developed as well as developing countries, that negligence of maintenance (specifically preventive and planned maintenance routines) can decrease productivity by tens of percents and proportionately increase the production costs.

The importance of proper maintenance management with the assistance of personal computers was recognized by UNDP and other international bodies concerned in 1987 when the European regional project RER/87/036 "Industrial Computerized Management Systems" was approved as a part of the UNDP regional programme for Europe. The aim of that project was defined as to address the topics of better management and higher utilization of national industrial resources through introduction and pilot implementation of computerized maintenance management system (CMMS) as a part of comprehensive computerized management systems (CMS). It has also been recognized by the participating countries in the regional project that such CMMS must be conceived and constructed as an open, modular system, which would enable that it be interfaced to (integrated with) other important computerizable managerial tasks such as production scheduling, control and monitoring, computer-aided drafting and design etc. Computerized production and maintenance management and control system is considered as one of such immediate future development stages.

The CMMS project activities should result in the development and application of computerized systems and other advanced techniques in maintenance environment of basic industries of the participating countries in the project, i.e. Bulgaria, Cyprus, Czechoslovakia, Hungary, Poland, Portugal and Yugoslavia, including:

- establishment of a co-operative network among relevant institutions in the participating countries;
- development, testing and application of industrial subsystems and modules by the national participating institutions (focal points) and their subsequent integration into the overall maintenance system for regional use;
- continuous exchange of information and accumulation of latest know-how and experience in the project subject;
- organization of joint training programmes for national specialists in specialized project fields.

The project is of a capacity building nature resulting not only in development of numerous applications of computerized maintenance systems during the project time, but also in further development, repeated applications, training, consultancy and other forms of regional co-operation of permanent self-sustaining nature based on the facilities to be established by the project.

The Joint Euro-Arab Workshop (DU/RAB/89/022) was oriented towards Arab countries and was meant as the pilot event facilitating transfer of know-how accumulated during implementation of the UNDP/UNIDO regional project RER/87/036; transfer of know-how from one region to another region and at the same time with the aim to multiply the outputs of regional projects through outreach activities towards other regions. The workshop was designed to establish the organizational basis for launching of regional/national development projects in Arab countries focussed on the utilization of computers in maintenance management systems of industrial enterprises based on experience obtained in implementation of the UNDP/UNIDO regional project RER/87/036.

II. Election of Chairman and Vice-Chairmen

The meeting was opened by Mr. Chladek, Chief Adviser, UNIDO-Czechoslovakia Joint Programme for Co-operation in Metallic Industries. The opening speeches were delivered by Mr. Boulares of UNDP, Mr. Krouzek and Mr. Al-Hafedh of UNIDO and Mrs. Trkalova of INORGA Institute, Prague, Czechoslovakia.

The meeting elected Mr. S. Chladek as Chairman of the Workshop. Messrs. Al Dewachi, Executive Director, Information Processing Centre, Iraq and E. Maarouf, Consultant Engineer, Egypt, were elected Co-Chairmen. The workshop elected the following Committee for preparation of the final report: Mr. Bourahla Saad, Computer Specialist, SIDER, Algeria; Mr. Adel Hussein, Director of Maintenance, EISCO, Egypt; Mr. Zain El-Abdin Tahboub, Assistant Professor, University of Jordan; Mr. K. Zbrakovsky, Expert of UNIDO-Czechoslovakia Joint Programme; Ms. R. Ivasenkova, UNIDO-Czechoslovakia Joint Programme; and Ms. G. Hynek, Research Assistant, Metallurgical Industries Branch, UNIDO.

At the request of the Chairman, all participants introduced themselves and their companies/institutions.

III. Objectives of the Workshop

According to the Aide memoire and programme of the Euro-Arab Workshop on CMMS, the workshop objectives as envisaged by UNDP and UNIDO were as follows:

(a) To provide information on activities, achievements and plans for the future of the European regional UNDP/UNIDO project RER/87/036 including the application of Computerized Management Systems (CMS) as an umbrella concept comprising Computerized Maintenance Management Systems (CMMS), Computerized Production and Maintenance Management Systems (CMMS) etc.

(b) To discuss and agree on a co-operative network programme concerning the development/utilization of CMMS for basic industries for Arab countries.

(c) To discuss and finalize a project proposal for a regional project for Arab states and/or possibly a set of project documents for CMS applications for the Arab countries, that are interested to join the network.

(d) To identify the National Focal Point Institutions (NFPIs) that will participate in the Arab regional project and to develop a framework for cooperation between European and Arab projects.

(e) To agree on a standard model for preparation of the national projects on CMMS industrial application to be financed from the national IPFs and to identify potential end-users in relevant Arab countries.

The workshop addressed the following topics:

- (a) introduction to the principles and modalities of technical assistance provided by UNDP to developing countries
- (b) introduction to the principles and modalities of technical assistance provided by UNIDO to developing countries
- (c) overview of UNDP/UNIDO European regional project RER/87/036 objectives, activities and goals attained so far
- (d) assessment of Arab regional/national development needs and potentials concerning Computerized (Maintenance) Management Systems (CMMS)

IV. Deliberations of the Workshop

1. Introduction of the principles of UNDP

This is available in the Proceedings of the Euro-Arab Workshop on CMMS, handed out to participants in the Workshop. The UNDP representative, Mr. Boulares specifically referred to the achievements obtained by the European regional project on Industrial Computerized Management Systems and outlined some of the activities. He favored project implementation through networking arrangement and the establishment of a steering committee that would meet on a regular basis to agree concerted action and activities by all members of a regional project. He encouraged all actions that would be tailored towards co-operation between the European and the Arab Region.

2. Introduction of the principles of UNIDO's technical assistance (available in a separate paper "UNIDO's technical assistance programme to the metallurgical industries sector of developing countries", handed out to participants)

Special reference was made to projects on CMMS in Europe, the Arab States and other regions. Information on UNIDO's activities related to the Introduction of Computerized Managed Maintenance in Metallurgical Industries is contained in Annex IV to this report.

3. An outline of the European Regional Project RER/87/036 Industrial Computerized Management Systems was provided by Czechoslovakia. This was followed by presentations by representatives from the other five European focal point countries, namely Bulgaria, Hungary, Poland, Portugal and Yugoslavia. These presentations are available in the Proceedings handed out during the workshop.

4. The following participants informed on activities related to computerized maintenance management systems in their respective countries

Algeria (Mr. Bourahla of SIDER); Egypt (Mr. Hussein of EISCO); Syria (Mr. Khubeize from Scientific Study and Research Centre); Iraq (Mr. Al-Dewachi, Executive Director, Information Processing Centre, Ministry of Industry); Jordan (Mr. Tahboub of the University of Jordan); and Mr. Sahouli of the Arab Iron and Steel Union.

The presentations referred to the availability and utilization of computers in industrial operations, particularly in plant maintenance. Some of the main issues can be reported as follows:

(a) Mr. Al-Dewachi from Iraq described the national experience in the field of computer application. He introduced the Information Processing Centre (IPC) in Baghdad, which was established in 1983 as a semi-independent unit of Ministry of Industry and which employs about 50 staff members. The list of clients of the Centre comprises nowadays about 35 industrial enterprises operating minicomputers such as HP 3000 and some 70 networked PCs. In 1990 the Centre expects to service/operate more than 25 minicomputers HP 3000, about 16 VAX 3400, 150 PCs networked in more than 10 local area networks (LANs) etc. Application of computers is mainly directed towards accounting, personnel, inventory, purchasing, production and sales and also maintenance management. Concerning managed maintenance, the Information Processing Centre relied on UNIDO assistance with UNDP and Arab Fund financing, with international participation from West European countries which resulted in development of an own package for CMMS being nowadays operated in the Centre. For regional projects, the importance of a common language for technical terms and definitions was stressed. In this regard reference was made to a dictionary issued by IPC with relevant terms explained and translated into Arabic. Iraq expressed preparedness to act as a focal point for the future Regional Project, but wants to build up on already accumulated knowledge and experience. UNIDO should make use of available facilities/experience in the Arab region countries. The importance of training was also stressed. Mr. Al-Dewachi invited all participants to attend the first international conference on CMMS in Baghdad in 1991. He requested that UNIDO should organize a side-meeting at the occasion of the Conference and to sponsor participation by selected Arab countries.

(b) Mr. Tahboub of Jordan informed about the maintenance practices in industry in Jordan, which - according to the standards of the industrially most developed countries - require support in order to be upgraded. He referred to the maintenance facilities at the airport as being one of the most modern in the world. He also mentioned that maintenance of assets can be ordered and provided by specialized small companies in Jordan on the base of contracts. The workshop was informed that an expert system, SOLVER, is being utilized for fault diagnostics at the University of Jordan in Amman. He confirmed that the University of Jordan would be prepared to act as focal point in the regional project.

(c) Mr. Hussein of Egypt informed on the national UNDP/UNIDO projects on CMMS systems, which were implemented at EISCO. Annex IV on UNIDO's activities in CMMS also provides information on this project. He appreciated the supportive role of UNDP and UNIDO. He informed that based on the development effort related to the national UNDP/UNIDO project, own CMMS packages were developed

by EISCO staff in the own software house and are provided nowadays on a commercial basis to a number of Egyptian companies. Egypt offered to share their experience and to host the suggested regional meeting in 1990 during which the project document for the large scale project will be elaborated, based on diagnostic missions undertaken under preparatory assistance.

(d) Mr. Bourahla of Algeria outlined the layout of SIDER's main steel plant at El Hadjar and informed about the ongoing national UNDP/UNIDO project for introduction of modern production and maintenance management systems at Annaba. He stressed the necessity of proper maintenance practices being supported by computerized maintenance management systems. SIDER expressed also its preparedness to act as a focal point for the regional project.

(e) Mr. Khubeize of Syria informed about the national activities in the field of computerized management systems. At present three main computing centres are operated in Syria together with a network of many PCs. However, the maintenance practices and CMMS systems in particular will require extensive development effort and support and readiness was expressed by the Scientific Studies and Research Centre to act as focal point institution in the large scale regional project.

(f) Mr. Sahouli of AISU informed about the activities of AISU in the field of computerized management systems in basic industries. He mentioned the usage of "HP Maint" package. Being a regional Arab organization with connexions to many industrial plants, the workshop suggested and AISU agreed to act as the main co-ordinating body for the regional project. First of all, AISU would assist UNIDO in preparing the project document for the preparatory assistance phase of the project. He mentioned also the latest UNDP/UNIDO projects, specifically the project for introduction of production and maintenance management systems to basic industries.

(g) It was agreed that Algeria, Egypt, Iraq and Jordan would encourage their Governments to officially request and endorse the proposed preparatory assistance document which, by its nature, would need three official endorsements in order to be approved by UNDP.

5. Discussions during the Workshop, activities towards launching a regional project for Arab States

It was stated that the WIMS (Works Information Management System) package which was used as the basis for awareness and extension development work by the European regional project RER/87/036 was not considered to be the optimum system for the Arab States due to a number of its limitations (e.g. system functions, user facilities, modern features such as windowing, etc.) and the already advanced stage of CMMS development in various Arab States, particularly Algeria, Egypt, Iraq and Jordan.

Regarding the functions of the CMMS package, it was agreed that all standard functions would be incorporated, e.g.

- long-term maintenance planning
- maintenance scheduling
- material requirements and spare parts planning
- inventory control and purchasing
- maintenance monitoring

The more advanced functions of condition based maintenance/plant condition monitoring, history analysis and forecasting, spare parts production planning, budgeting and cost control should also be included. Depending on available resources the use of expert systems for diagnostic purposes should also be considered.

Further requirements on the system would be modularity, flexibility, adaptability as well as transportability, user-friendliness, system documentation availability. The system should also provide for generic applications in order to achieve a multiplier effect. In any case, a survey should be carried out on the available modern application software packages meeting the above requirements.

The envisaged regional project should be oriented primarily towards maintenance management systems with possible linking to production systems. The regional project should be based to gear the development towards CMMS, which could be run in different operating environments.

The co-operative network programme will not be limited to focal point institutions but envisages the participation of both the governmental and private sector as well as parastatal enterprises as pilot application plants assigned to network focal points. In this regard it was considered that the enterprises/organizations in the respective countries participating in the workshop would form a good basis for acting as focal points in the future network. Specifically, the following companies/organizations could form the network focal points:

Algeria - SIDER - Iron and Steel plant El Hadjar

Egypt - EISCO - Egyptian Iron and Steel Company

Iraq - Information Processing Centre, Ministry of Industry

Jordan - University of Jordan

Libya - yet to be identified

Morocco - SONASID - National Steel Co. of Morocco

Syria - Gecosteel and Scientific Studies and Research Centre

Tunisia - Societe Tunisienne de Siderurgie

It was agreed among the Arab States that the Arab Iron and Steel Union, by nature of its activities, should be appointed the leading focal point institution in the network responsible for the overall co-ordination of the activities. However, the role of AISU will be defined during the preparatory assistance phase. Apart from an overall co-ordination body the Steering Committee would be the basis for regional activities. As successfully practiced in the European regional project, the Steering Committee would be composed of representatives from all participating Arab countries who would meet on a rotating basis to define the actions to be taken and split the activities according to the best capabilities. It was agreed that the first meeting of this kind, with representatives from the focal points should be organized at EISCO, Cairo, Egypt, to discuss the findings and recommendations of the preparatory assistance diagnostic mission, proposed to be undertaken as the next logical step towards launching of the regional project.

Reference was made to a Conference on maintenance management in Iraq which will take place in early 1991. This was considered an important event which could contribute towards the aims of the regional network project. A separate meeting could possibly be planned for interested participating Arab countries at that occasion. UNIDO will make all effort to promote this conference.

Regarding the project proposal for the regional project on CMMS in Arab Countries the UNDP representative indicated that the Project Document would not be finalized at the Euro-Arab Workshop but at a later stage to be completed after consultations with the national counterparts and that the results of the discussions of the Workshop should be taken into account.

Under preparatory assistance, it was recommended to undertake a diagnostic mission to establish the exact needs of the individual countries, to assess available facilities and to come up with a project that would cater to the individual needs to the largest extent possible while, at the same time, taking into consideration the different development stages of CMMS awareness in the Arab region countries.

6. Proposal for the Arab Regional Project on CMMS

The outline for the regional project was discussed. The envisaged regional project is expected to have the following four main objectives:

Objective 1: The establishment of a network of national technical institutions and plants to develop jointly and introduce Computerized Maintenance Management System (CMMS) to the metallurgical and other industries in the Arab Region.

Objective 2: The development and provision of necessary comparable standardized CMMS software and applicable hardware systems appropriately designed and adapted for the national production units.

Objective 3: The execution of Pilot Plant CMMS application activity including the preparation of a set of recommendations for CMMS implementation and efficiently executed training programmes for management and end-user manpower in the development and operation of CMMS.

Objective 4: Dissemination of the CMMS concepts, know-how and application procedure to metallurgical and other industries in Arab countries.

The envisaged project outputs, in connection with the objectives and activities, as well as other prerequisites necessary for the design of the project document, including the work plan will be prepared during the preparatory assistance phase of the project and finalized during the preparatory project network meeting in Cairo. It was recommended that UNIDO, in consultation with the Arab Iron and Steel Union, would draft a preparatory assistance project document for this purpose.

Envisaged Outputs of the Regional Project

Outputs in connection with Objective 1

- 1.1 Fact finding report of international expert/consultant with proposals and recommendations for the establishment of the network of national technical institutions and plants for the project implementation, together with detailed requirements and structuring of responsibilities and involvement of all parts and levels of the network, as well as a detailed cost-benefits assessment of the project.
- 1.2 Network of national technical institutions and plants (focal points) capable of joint development and introduction of CMMS to metallurgical and other industries.
- 1.3 Proposal of detailed Project Work Plan to be agreed upon by the network's coordinators meeting and the project's network Steering Committee set up during this Meeting.

Outputs in connection with Objective 2

- 2.1 Comparative study of available personal and minicomputer and networking and communications hardware suitable for the standardized support of CMMS application, with recommendations on suitable hardware.
- 2.2 Requisition for the purchase (if necessary) and installation of recommended hardware facilities for selected pilot CMMS development and focal points of the project network.
- 2.3 Comparative study on available CMMS application software with recommendation in respect of subcontracting the selected CMMS software supplier(s) and for further work in connection with the re-design and adaption of the software for different focal points or national organizations.
- 2.4 A number of CMMS application main subsystems and modules developed or re-designed and customized by/for focal points' organizations.

Outputs in connection with Objective 3

- 3.1 Parallel CMMS pilot application of subsystems/modules in selected plants of Arab countries participating in the network.
- 3.2 Recommendations on CMMS implementation modalities and mechanisms, including:
 - appropriate management and organizational structure;
 - selection of pilot plant implementation areas;
 - implementation steps for the introduction of individual CMMS functions and their overall integration.

- 3.3 A number of training programmes on CMMS concepts, developments and benefits organized for the selected management and end-user personnel, one in each of the network's countries in cooperation with the focal point institutions and plants.
- 3.4 A two-week training programme on CMMS design and standardization and development for the network's coordinators and selected system development personnel from the focal points organized in co-operation with the CMMS software sub-contractor.
- 3.5 A series of 1-5 days training seminars for selected end-user personnel according to the hierarchical management levels organized for each focal point in individual countries by national coordinator, system designers and subcontracting expert.
- 3.6 Two 3-week study tours of national coordinators and senior managers to selected developing and developed countries with advanced CMMS applications dedicated to the CMMS development and implementation problems.

Outputs in connection with Objective 4

- 4.1 CMMS management guide and end-user manuals and other relevant documentation and publicity literature published by the network coordinating focal point.
- 4.2 Set of CAI (Computer Aided Instruction) documentation programmes and videofilms for the dissemination of CMMS know-how prepared by network focal points according to their CMMS subsystems developments.

The main activities of the project, yet to be defined through the preparatory assistance mission and subsequent meeting will essentially be that the participating countries will establish a network composed of national institutions which will be the network's focal points in the participating countries. Each participating Arab country will provide a lead institution and a small staff to spearhead the operation of the network headed by an appointed national coordinator and directed by the Regional Steering Committee. The participating countries will nominate national coordinators to head the network's focal point institutions in the participating countries.

7. Adoption of the Report

The draft of the Final Report on the Workshop, including the draft outline of the proposed regional Arab project, was discussed and agreed upon at the workshop meeting on 16 February 1990.

V. Conclusions and Recommendations of the Workshop

- (a) Arab countries suffer from the lack of proper and consistent maintenance management, maintenance organization and maintenance planning. Although the situation varies from country to country, and varies from one plant to another, negligence of proper maintenance harness the development potentials.
- (b) The workshop participants from Arab countries expressed their gratitude to UNDP, UNIDO and Czechoslovakia for their effort to organize the workshop as an attempt to promote co-operation between the European region and the Arab region within the framework of a Euro-Arab regional project. All workshop participants expressed unanimously that such meetings are of great benefit for all participants as a basis for exchange of experience, opinions etc. concerning development and utilization of CMMS in industry.
- (c) It was emphasized strongly that regional co-operation in the area of CMMS in Arab region countries needs to be promoted for the benefit of all countries concerned, being at the same time adjusted to topical needs of every country.
- (d) The Workshop strongly requested that a regional project on CMMS in metallurgical and other industries be launched with the assistance of UNDP/UNIDO. The project should mobilize national capabilities and multiply effects of national/regional achievements. The detailed scope of the project objectives, outputs and activities should be defined through a preparatory assistance phase.
- (e) UNIDO was requested to formulate a Project Document in consultation with AISU for the preparatory assistance phase. The preparatory assistance should comprise diagnostic missions to individual Arab countries, which are expected to participate in the Arab Regional Project on CMMS. The diagnostic missions should also identify and assess the National Focal Points as the core of envisaged project network. The findings of the diagnostic missions will be discussed at the meeting of CMMS responsible people from Arab countries to be held at EISCO in Cairo in 1990. Representatives from the European regional project will also be welcome. The principal output of this meeting will be an agreed Draft Project Document of the Arab Regional Project on CMMS being ready for endorsement by participating Arab countries.

Annex I

UNDP/UNIDO PROJECT DU/RAB/89/022
EURO-ARAB WORKSHOP ON CIMS
Prague, 12-16 February 1990

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Annex II

Euro-Arab Workshop on CPMIS

Programme of the Workshop

Monday - 12 February 1990

- 09:00 Registration of participants
- 15:00 Individual discussions with UNDP, UNIDO and JP/MI representatives at the JP/MI Centre, demonstration of the ORION System for Production Scheduling and Control (as an example of either stand-alone systems and/or the WIMS package enhancement system), demonstrations of some advanced computerized management packages (DYNAR, PLARIN)

Tuesday - 13 February 1990

- 09:00 Official opening of the Workshop (representatives of UNDP, UNIDO, INORGA Institute, UNIDO- Czechoslovakia Joint Programme, Federal Ministry of Foreign Affairs, Federal Ministry of Metallurgy, Engineering and Electronics)
- 09:30 Introduction to the principles of UNDP technical assistance programmes and regional projects of technical assistance activities for Europe and Arab states, framework for the preparation of Arab regional/national projects, potentials and recommended guidelines for further cooperation enhancement between European and Arab regional projects (UNDP representative)
- 10:30 Introduction to the principles of UNIDO technical assistance programmes and regional technical assistance activities, overview of UNIDO-executed regional programmes in Europe and in Arab states, overview of technical assistance forms provided by UNIDO (UNIDO representative)
- 11:30 Overview of JP/MI Centre scope of activities, objectives and forms of technical assistance provided to developing countries (JP/MI representative)

- 14:00 Computerized Management Information Systems in Industry and European regional UNDP/UNIDO project RER/87/036 "Industrial Computerized Management Systems"
- 15:00 Introduction to and demonstration of the Works Information Management System (WIMS) (JP/MI representatives)
- 16:00 Concept of Arab regional project (national projects) on Computerized Production and Maintenance Management System as an outreach programme of European UNDP/UNIDO regional project RER/87/036 (UNDP, UNIDO, JP/MI representatives)

Wednesday - 14 February 1990

- 09:00 Presentation of National Reports by the European countries' representatives participating in the RER/87/036 project
- 10:45 Presentation of National Reports by the European countries' representatives participating in the RER/87/036 project - continued
- 14:00 Discussions on CMIS and CMMS in industry in Arab states as a vehicle for industrial performance increase - development needs specification, national potentials upgrading possibilities etc. (UNDP, UNIDO, JP/MI representatives)
- 16:00 Presentation of national reports by the representatives of the Arab states concerning the status of maintenance activities in their national industrial, data on the level of capacity utilization, maintenance cost, national needs and requirements in CMMS and CMIS etc.

Thursday - 15 February 1990

- 08:30 Departure for the visit of POLDI Steelworks Plant in Kladno

09:30 Industrial visit to POLDI Steelworks Plant in Kladno - demonstration of CIMS installation and modern computerized control system of continuous technological processes in metallurgy (POLDI Kladno experts)

Friday - 16 February 1990

09:00 Final discussions, adoption of the Final Report and Recommendations on Measures to be taken by UNDP, UNIDO and the participating countries

10:45 Official closing ceremony

p.m. Follow-up discussions

Annex III

Available background documentation

1. UNIDO's Technical Assistance Programme to the Metallurgical Industries Sector of Developing Countries, issued November 1989. May be obtained from UNIDO, Metallurgical Industries Branch, P.O. Box 300, A-1400 Vienna, free of charge.

2. Proceedings: Euro-Arab Workshop on Computerized Maintenance Management Systems. Distribution: Restricted.

Contains information on UNDP and UNIDO activities; overview of the UNIDO-Czechoslovakia Joint Programme for Co-operation in Metallic Industries; Computerized Management Information Systems in Industry and European Regional UNDP/UNIDO Project RER/87/036; and contributions by Bulgaria, Czechoslovakia, Hungary, Poland, Portugal and Yugoslavia related to computerized maintenance systems.

Annex IV

Information on UNIDG's activities related to the
Introduction of computerized Managed Maintenance Systems
in Metallurgical Industries

UNIDO, in particular the Metallurgical Industries Branch, is fully aware of the industrial maintenance management problems (inadequate maintenance being specifically costly for the large capital asset investments into rapidly established steel plants in developing countries) and started as early as 1972 organisational studies to create due awareness of this problem in developing countries. Studies were undertaken for Hungary (Dunaiváros Steelworks), a computerized managed maintenance system (CMMS) was introduced into the Egyptian Iron and Steel Company, Helwan, followed-up by implementation of CMMS in Czechoslovakia (East Slovakian Steelworks, Kosice). Another preparatory assistance project was undertaken for SIDERMEX in Mexico in 1985, with a follow-up cost-sharing project for AHMSA and SICARTSA steelworks. A large scale project on the introduction of CMMS into the Steel Authority of India (1986 Rourkela Steel plant with follow-up transplant to Bhilai and Bokaro steelplants) was successfully implemented and regional projects for ASEAN and Arab countries are about to commence.

1. Ongoing or implemented technical assistance projects

More detailed information is provided on the projects in Czechoslovakia, Egypt, India and Mexico, as well as an outlook for future perspectives.

(a) Czechoslovakia: Introduction of the CSSR UNDP/UNIDO project on computerized maintenance systems

The growth of range and costs of maintenance and repairs in CSSR metallurgical industries was marked by a steady 5.5 % increase per year during the decade 1971-1980, the value of the new sophisticated installed and rehabilitated production facilities having been more than doubled during that period. Consequently, the demand for both qualified maintenance manpower and management and planning personnel had also grown and the necessity for rationalization and improvement in maintenance productivity, planning and management arose. In order to meet these needs of metallurgical industries within the framework of CSSR industry development plants, UNDP/UNIDO assistance was requested in the "Application of a Modern Maintenance System in the Iron and Steel Industry" and became operational in 1979, for a duration of about 4 years, including follow-up activities. The CSSR Federal Ministry of Metallurgy and Heavy Engineering represented by INORGA Research Institute for Industrial Management and Automation, Prague, was appointed as Government Co-operating Agency, providing the requisite framework, project management and counterpart organization in co-operation with the East Slovakian Steelworks, Kosice, where the computerized managed maintenance system was installed. Whilst the Government provided existing computer facilities, salaries for counterpart, building, etc. the UNDP contribution to the project was of the order of 1.06 million, essentially covering consulting services, equipment and training.

Project activities covered major maintenance subsystem structuring and development, procurement and installation and operation of computer and communications hardware facilities, consultancy subcontracting and software packages development, extensive home and international training as well as the follow-up activities in the dissemination of know-how upon project completion.

Apart from the project's intangible benefits such as better information for decision-making and spare parts supply as well as budgeting, smoother work load on a long term basis, standardization, etc., concrete annual savings of about 63 million crowns were achieved, due to lower inventory levels of spare parts, due to increased volume of assemblies and spare parts reconditioning, due to lower imports of spare parts, due to increased productivity of standardized assembly repairs, due to lower downtimes of key production facilities, due to improved planning of repairs and manpower utilization, due to lower rescheduling of maintenance jobs and transportation times. The project has favoured technical co-operation among developing countries (TCDC) as it provided training on CMMS development, on an international level and under UNIDO auspices, to other countries like Algeria, Egypt, India, Mexico.

(b) Czechoslovakia: National Technical Consultancy and Training Centre (NTCTC)

In order to meet the requirements of national development plans of Czechoslovakia which demanded an increase in productivity and efficiency of basic industrial sectors, the establishment of a National Technical Consultancy and Training Centre for computer techniques in metallurgical and other basic industries was agreed and UNDP/UNIDO assistance requested.

The project was to capitalize the results achieved in the field of computer applications during the implementation of two large scale projects related to the Application of a Modern Maintenance System in the Iron and Steel Industry and to Assistance in Computer Aided Design and Manufacture (CAD/CAM) in Machinery Building Industry.

For project implementation, the Government authorities provided existing computer facilities, laboratories and introduced new computer and terminal facilities and staff. UNDP inputs amounted to \$ 0.8 million, mainly covering equipment, expertise and training to set-up an operating computerized data bank, development of a pilot small-batch and single-piece production control system and other industrial software; set-up of a nucleus for provision of professional consultations and expertise for basic industries oriented towards production control systems and maintenance management systems, CAD/CAM, etc., establishment of training capability. The successful implementation of the project has contributed through NTCTC operation to the extended and speedy introduction of advanced computer aided systems and techniques into metallurgical and basic industries and will continue to provide this possibility. The NTCTC provided as a part of this activities also numerous expert, consultancy and training services to counterparts in developing countries. This led to the establishment of the UNIDO-Czechoslovak Joint Programme for Co-operation in Metallic Industries which, within a European regional outreach programme under UNIDO auspices, as well as bilaterally, continues these activities e.g. through the organization of Network Steering Committee Meetings and other Workshops, training and TCDC activities.

(c) Egypt: Establishment of managed maintenance system at the Egyptian Iron and Steel Company (EISCO)

Financed from UNDP contribution and with UNIDO as executing agency, a computerized managed maintenance system covering practically all departments of EISCO was installed. Technical assistance to the Egyptian iron and steel company and follow-up projects covered expert and sub-contractor consultancy services, a large training component and equipment installation. The introduction of CMMS has led to a significant increase in production as well as in savings accruing from improved stock control and organization of spare parts manufacture. Through the project a professional group of computer staff consisting of systems analysts, programmers, operations co-ordination personnel was formed and resulted in improved planning for spare parts requirements and more effective shop loading.

The Egyptian Iron and Steel Co. has spread the computerized system throughout its complex with an increase in production of 12 % and savings of US\$ 8 million (figures are based on an assessment made in 1985) resulting from organized inventory systems, effective utilization of spare parts and elimination of unexpected failure of machinery. The system was introduced in four companies.

From the successful introduction of CMMS at EISCO, a number of other spin-off projects evolved, namely "Intercountry project for managed maintenance" under which a "Demonstration Workshop on Managed Maintenance in Metallurgical and Foundry Industries for African Developing Countries" was held in Cairo from 26 March - 15 April 1983. A Second Regional Demonstration Workshop on Managed Maintenance in Metallurgical and Foundry Industries for African Developing Countries was held in Cairo from 17 November - 7 December 1984. Training programmes were organized for Somali and Pakistani trainees. A UNDP/UNIDO/EISCO diagnostic mission was organized to identify areas of co-operation with African industrial establishments.

EISCO is now operating as a National Centre for Managed Maintenance in metallurgical and other basic industries. The Centre was officially inaugurated in March 1988, at the occasion of the Opening of the Second UNIDO Expert Group Meeting on Computerized Maintenance Systems in Metallurgy, held in Cairo from 6 - 12 March 1988. Now the concept of regional co-operation in managed maintenance of metallurgical and other industries needs to be promoted.

(d) India: Introduction of CMMS in plants of the Steel Authority of India Ltd.

Under a UNDP financed and UNIDO executed project CMMS was introduced into the Rourkela Steel Plant starting in April 1986. The system has the following modules:

- i. planning of preventive maintenance and repair and scheduled shutdowns
- ii. upgrading the present system of procurement and inventory control for sub-assemblies, assemblies and stores
- iii. effective planning in manufacturing and reconditioning spare parts within the steel plant and other indigenous workshops.

In addition, the project foresees the establishment of a specialized data bank at the steel plant to record and technically codify spare parts and material supplies to support the above sub-systems.

Special attention is given to the training of specialists in various fields of computer managed maintenance.

CMMS packages were developed in-house with the support from international sub-contractors. In the software development more than 10 computer engineers and 10 maintenance engineers were involved. The project is about to be completed. The benefits obtained so far are those associated with CMMS awareness and improved computer application. Particular mention may be made of the following results which could be achieved: in preventive maintenance and repair, in the pilot area blooming and slabbing mill, delays due to mechanical, electrical and cranes availability could be decreased from 663 hours annually to 385 hours. In the material planning module, the introduction of centralized procurement instead of departmental procurement has led to a reduced workload of the individual departments by about 20 - 25 % in terms of procurement value and 50 - 75 % in terms of manhours. This has proved that computerization of material management activities is a step towards automation with possible scope for reduction/redeployment of manpower. CMMS development and implementation in all plant areas will bring ultimate benefits in higher plant availability, increased manpower productivity, reduced stores, higher production of spare parts and reconditioning and better financial control of maintenance function. It is planned to duplicate the system for the Bhilai and Bokaro plants of the Steel Authority of India Ltd. Personnel from both plants already participated in study tours, awareness programme and system design phase. The project developed a good potential for transfer of know-how to other industries and TCDC.

(e) Establishment of a Computerized Management Maintenance System at SIDERMEX, Mexico

Based on preparatory assistance carried out in 1985, a project was launched and pilot departments, namely Blast Furnace No. 5 and hot mills for Ahmsa and the rod mill and coking plant for Sicartsa, were chosen for introduction of CMMS. The project team developed an on-line transaction oriented system, called SIMA (Sistema Integral Mecanizado de Administracion de Mantenimiento), which covers six modules, namely: preventive maintenance, shops, evaluation, planning and scheduling, warehouse and purchasing and overall maintenance feedback monitoring. Presently, an important new component is being added to the system: the plant condition monitoring which provides on the process control level important feedback to the SIMA system. This sets the trend for the future when all major production facilities of the plant should be covered by this type of systems to enable not only monitoring but also forecasting of future reliability and thus to improve the preventive maintenance planning and to prolong life of equipment. Personal computers are introduced thus proving that distributed processing approach is also effective as compared to mainframe computer application. Potentials for provision of training on national and regional level are envisaged to be opened by the project.

2. Future perspectives

Following the past pattern of successful introduction of CMMS in metallurgical plants UNIDO will also continue to assist this sub-sector as a means to save production costs. Envisaged projects aim to assist Algeria, the Arab region countries, Indonesia and the ASEAN countries; assistance will be continued to India and Mexico. The subject of CMMS will further be promoted through the organization of Expert group meetings and workshops. The Third Expert Group Meeting on Managed Maintenance Systems is planned to be held in

November 1990 in Singapore and a 3-weeks Workshop for African countries is planned for September 1990 to be held in Czechoslovakia.

One pre-condition for introduction of new technology, which is often neglected, is a proper functioning process and production control, automated and computerized. When planning the use of computer controlled plant monitoring, the metallurgical industries, being capital and energy intensive, deserve particular attention as they offer vast areas where improvements in productivity, efficiency and quality through the introduction of such systems can be achieved. Most innovations require computer control as an indispensable pre-condition. New technologies in the metallurgical industries, backed by the progress in automation, create new concepts which make old well-proven solutions obsolete. Optimization of production processes requires that entire production units and plants have to be covered with automation systems and computer control. Those plants and plant areas in which computerized production and process control can be introduced with most promising results will have to be identified. In addition to the productivity-increase type of goals, uniform product quality and timely deliveries based on customer's requirements are decisive factors for introduction of production and process control. Other benefits of industrial automation and computer application are increased yield, increased raw material utilization, increased plant availability, decreased specific energy consumption, decreased specific utility consumption and reduced manpower and personnel costs. Integrated automation systems are very complex, hierarchically structured and distributed. They may consist of several computers or computer systems, a large amount of distributed control systems and many related sub-systems. For a clearer structure, the functions are divided into logical levels. These are: Level 1: Basic automation; Level 2: production automation; Level 3: production control; Level 4: production planning; Level 5: management information system. It is expected that requests for UNIDO technical assistance in this field will be forthcoming from a number of developing countries. The following project concepts will give an idea to interested parties concerning the possible outline of such a project.

Project Concept No. 1

Title: Application of computer based production and maintenance management systems

Project objective:

To increase the utilization of production capacities of metallurgical and other basic industries through national and/or regional co-operative efforts in the application of computer based production and maintenance systems and introduction of related rationalization techniques.

Background information and justification:

Improved utilization of existing production capacities of 5 - 15 % and thus an increase of industrial output of existing plants can be achieved without additional capital investment, through the introduction of computer based maintenance and production control systems and related techniques, including among others

- basic production planning and scheduling
- preventive maintenance management
- materials, semi-finished products and spare parts requirements planning
- inventory control and purchasing
- spare parts manufacture and control

- production reporting and feedback
- maintenance monitoring and history analysis

UNDP/UNIDO executed projects carried out or under implementation on both national and regional levels during the last decade proved that this concept is fully viable with tangible benefits of increased plant productivity (by 5 - 10 %), lower levels of inventories and work in progress (by 5 - 20 %), improved utilization of manpower (by 5 - 10 %) and savings in the spare parts economics (by 15 - 25 %).

Project Outputs:

- National metallurgical company or focal point institution with corresponding local area networks and/or sub-networks of industrial plants (nodes) interlinking each other based on scope and character of system application;
- Application software consisting of a set of systems/modules for production and maintenance control, computerized documentation and production optimization support, to be developed/tested locally on pilot application, for possible use in network node plants (sub-networks); with corresponding documentation manuals;
- Local area networks of dedicated workstations and personal computers
- Trained personnel, through study tours for local and/or regional participants (computer engineers) from local company and/or regional pilot application plants (nodes);
- Engineers, computer specialists, managers and end-users trained in multiple fields of computerized production and maintenance systems, through training workshops.

Project Activities:

The project aims at development and application of computerized systems and other advanced techniques in production and maintenance environment of metallurgical and related basic industries through:

- development, testing and application of computer assisted systems for production control and plant maintenance, depending on specific application conditions and development priorities of a given country/plant. This will cover:
 - direct connexion between the production and process control systems
 - preventive maintenance and repair planning
 - real time spare parts control, planning, reconditioning and manufacturing
 - real time inventory and purchase control of spare parts, materials, sub-assemblies and assemblies
- Data Bank and teleprocessing creation to support the integration of the above functions.
- organization of training programmes and workshops

Implementation of the project by a consulting firm (UNIDO sub-contractor) should be envisaged, with some individual consultants to be recruited. The project is of both direct support and capacity building nature, resulting in direct, tangible benefits in industrial enterprises connected to the network development, but also in further repeated applications, training, consultancy (transfer of know-how) and other forms of co-operation within the country or region, of permanent self-sustaining network. The project may be implemented through linkage to mainframe computers, mini computers, and/or the application of personal computers. The latter approach will offer an inexpensive solution of application of computers to many smaller plants and companies.

Project Concept No. 2

Title: Computer application for production process control in the iron and steel industry

Project objective:

Through the introduction of computerized process control, quality control, production control, production planning, integrated information system, etc. to improve productivity and capacity utilization and the quality of the output, particularly for competitive advanced technology products.

Background information and justification:

Whilst developed countries have been introducing computers in production and process control since the 1960ies, developing countries are lagging behind, often a reason for poor capacity utilization of plants and poor quality products. It is clear that full-scale advantages offered by new technologies can only be implemented in new plants; however, existing plants can be refurbished and perfected with good results and cost savings as well as increase in product quality can be achieved.

When planning the use of computer controlled plant monitoring, the metallurgical and engineering industries, being capital and energy intensive, deserve particular attention as they offer vast areas where improvements in productivity, efficiency and quality can be attained. Optimization of production processes requires that entire production units and plants have to be covered with automation systems and computer control. Those plants and plant areas in which computerized production and process control can be introduced with most promising results will have to be identified. The benefits may be substantial particularly in the following areas: sinter plant, blast furnace, LD-plant, EAF-plant, ladle treatment plant, continuous casting plant and rolling mill. Process control and basic automation comprises functions which are usually performed by programmable logical controls, microprocessors and instrumentation systems. A distributed control system provides the following functions:

- direct acquisition of on-line data
- direct outputs of setpoints
- sequencing
- direct control
- interlocking
- change of mode of operation

LD-plant, ladle metallurgy, continuous caster, etc. Via serial interfaces and/or data highway they are linked to the main system and to each other to perform transmission of information and acknowledgement of results between production units. Each production unit can be operated autonomously. Their main functions are:

- Process monitoring
- process models
- co-ordination of partial processes
- recipe management
- operator guidance
- data gathering
- short range data storage
- quality control

In many cases, the optimization of the individual production units or processes is insufficient and production and quality control needs to be introduced. This calls for planning and co-ordination of all individual production units or processes in one plant and comprise the following main functions:

- entry of production orders
- scheduling
- mill pacing
- control of material flow
- control of production
- quality control
- operation sequence control
- determination of production conditions (process and product parameters)
- medium range data storage

Project Outputs:

- Project report by a consulting company with identified plant areas where the computerized process control will bring about maximum benefits.
- Evaluation of available hardware and software for installation.
- Equipment and software installed, and personnel trained in computerized production and process control system.
- Data Bank and documentation established.

Project Activities:

The project aims at development and application of computerized systems for process control. This will be achieved through:

- identification of relevant plant areas.
- procurement of hardware; development, testing and application of computerized systems for process control, depending on specific application conditions.
- direct connexion between other computerized plant systems, data bank, etc. to support the integration of the above functions.
- organization of training programmes and workshops.

Implementation of the project by a consulting firm (UNIDO sub-contractor) should be envisaged, with some individual consultants to be recruited. The project is of both direct support and capacity building nature, resulting in direct, tangible benefits in industrial units connected to the computer network. The project may be implemented through linkage to mainframe computers, mini computers, and/or the application of personal computers. The latter approach will offer an inexpensive solution of application of computers to many smaller plants and companies.

Project Concept No. 3

Title: Computerized Energy Conservation in Metallurgical Industries

Project objective:

The project will establish computerized energy auditing and monitoring and, in a later stage, a model computerized energy centre to serve the local metallurgical industries to monitor the production and utilize all energy to facilitate control over the distribution of such energy.

Background information and justification:

Through efficient energy management and adoption of adequate energy utilization and conservation measures, with the help of computer based methodologies for monitoring energy consumption rates at various production stages, substantial energy savings can be achieved. UNIDO may report a particularly successful project undertaken for steel plants of the Steel Authority of India Ltd. through which a number of areas for potential savings could be identified, including coke ovens, sinter plant, blast furnaces, OH steel stops, LD steel shops, continuous casting, primary mills, hot mill furnaces, etc. The findings and recommendations by the project will bring about total energy savings in these areas which are estimated at 6,020 Tcal/y for the Bhilai Steel Plant, 4,650 for the Rourkela Steel Plant and 6,550 for the Bokaro Steel Plant of SAIL. To obtain maximum benefits, the setting up of a computer network, such as done for the Ranchi Steel Plant in India, for energy management and monitoring should be considered. Energy conservation should particularly be directed to the following:

- elimination of wastes of different forms of energy
- improvement of operational practices to reduce energy consumption
- improvement of equipment design
- adoption of economic waste heat recovery
- adoption of modern energy efficient technologies
- establishment of a computerized energy centre for integrated energy control

Project Outputs:

Phase I

- Computer based methodologies for monitoring energy consumption rates at various production units (to be identified) of an iron and steel or other metallurgical plant

- Technical studies recommending means and measures to improve the energy consumption at the identified steel units.

- Identified potentials for energy conservation through systematic data collection.

- Mobile energy diagnostic laboratory; portable measurement instruments.
- Set up of a mini computer network linked to PCs and directly fed by energy related data from the mobile diagnostic laboratory.
- Energy Audit Manual (for carrying out audit of energy consumption and energy costs, to enable detailed variance analysis and identification of specific deviating factors.
- Plant engineers, trained in energy conservation.

Phase II - Establishment of a Computerized Energy Centre

- Preparation of a detailed plan for the establishment of a centre, incl. technical feasibility study report
- One model centre established at one selected steel plant

Project activities:

It is proposed to implement the project through a consulting company (UNIDO sub-contractor) and individual consultants as need may be. Activities will be in line with desired outputs and will specifically cover:

For Phase I:

- Preparation of computer based methodologies for monitoring energy consumption rates at various production units (to be identified);
- Preparation of technical studies recommending means and measures to improve the energy consumption at the identified steel units.
- Establishment of a data bank.
- Procurement of mobile energy diagnostic laboratory; portable measurement instruments; introduction to use of instruments
- Procurement and set up of a mini computer network linked to PCs and directly fed by energy related data from the mobile diagnostic lab. Procurement/development of required software.
- Preparation of Energy Audit Manual (for carrying out audit of energy consumption and energy costs, to enable detailed variance analysis and identification of specific deviating factors.
- Training programme for plant engineers.

For Phase II

- Preparation of a report with complete list of equipment/instruments for the energy conservation centre;
- Development of software packages, procurement of software, adoption, testing and operation.
- Physical establishment of Energy Conservation Centre; advisory services by consultants, as required.
- Training (local and abroad) of Centre staff.

Project Concept No. 4

Title: Software Development and Training Centre

Project objective:

To improve the self-reliance and to increase a country's independence on foreign software development/procurement by making full use of available national intellectual human resources for the automation of the metallurgical and other basic sectors of the economy, thereby saving foreign exchange for the import of software "know-how" and licenses and adaptation to local requirements.

Background information and justification:

With the advent of micro-electronic revolution the ratio of software cost to hardware cost in computer projects has considerably changed. As a result of this development, a higher share of computing cost is now attributable to software. Since software is basically an intellectual product, the investment needed to create a domestic software industry is mainly in the area of education and not, therefore, to be considered as a substantial capital equipment. The establishment of software development centres at both national and company levels can enhance and speed up the introduction of computer-aided process control systems. In this regard the metallurgical sector can highly benefit through the coordination and concentration of national capabilities of software development. The software centre will permit a better and more efficient use of national human resources in developing software for the industry and in adapting modern technologies to the national conditions. Further, the centre could extend its activities in providing assistance in introducing and upgrading computerized process controls to other basic industries at both national and regional levels.

Project Outputs:

A full-functioning Software Development House with trained staff who will elaborate, based on clients' requests, required tailor-made software, adapt software to local conditions and cater for training needs.

Project activities::

The work in this field will focus on:

- Providing assistance in the attainment of experience and know-how to establish a software development and training centre
- Providing assistance to develop methodologies and training activities aimed at upgrading the national capabilities of software development.
- Providing assistance and consultancy in the selection and acquisition of reliable hardware and equipment and in the development of comprehensive methodologies of training.

A project of this nature is being now prepared to be undertaken for the Steel Authority of India Ltd. and it is expected that technical assistance in this field will be requested by a number of developing countries; indications of interest, e.g. from Mexico, already exist.