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Expert Group Meeting on Technical
Assistance in the Field of
Maintenance and CAD/CAM*

Oslo, Norway, 12-17 March 1989

REPORT**

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* Organized by UNIDO in co-operation with the Norwegian Maintenance Association.

** This document has not been edited.

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INTRODUCTION

1. The expert group meeting on "Technical Assistance in the Field of Maintenance and CAD/CAM" was held at Oslo, Norway, from 12 to 17 March 1989. The meeting was organized by the United Nations Industrial Development Organization (UNIDO) in co-operation with the Norwegian Maintenance Association (NMA).

2. The purpose of the meeting was to offer a platform to high government officials to exchange views on technical assistance needs, which then would initially be discussed and elaborated with Norwegian experts and with those attending the international Norwegian meeting, where appropriate. The attendance at sessions of the International Meeting and Fair would possibly provide participants from developing countries with assessesd information on European know-how, technology and consultancy capacities in the field of maintenance and CAD/CAM applications. This would enable governments of the participating countries to present technical requests that adequately reflect their needs and possibilities.

I. PARTICIPATION

3. The expert group meeting was attended by experts from the following countries: China, Indonesia, Iran, Kenya and Vietnam. The participants represented the following organizations: China Association of Plant Engineering, Metal Industry Development Centre in Indonesia, Iran Tractor MFG Company, Kenya Industrial Research and Development Institute and Research Development Center in Electronics and Informatics of Vietnam. The list of participants is attached as Annex I. Two representatives of UNIDO (Engineering Industries Branch) attended this meeting, as well as one consultant in Tero management, the managing director of TERO Management Consulting A/S (TMC).

II. OPENING SESSION

4. The meeting was officially opened on Sunday, 12 March 1989, by UNIDO's representatives in the presence of the participants from the developing countries. Background information on UNIDO was provided and the organizational structure, activities and goals of UNIDO were explained. Technical co-operation activities of the Engineering Industries Branch in the field of maintenance was emphasized.

5. Different financial modes of technical co-operation were explained. There is the possibility of using different funds, which are: Indicative Planning Figure (IPF), Industrial Development Fund (IDF), Regular Budget (RB), Special Industrial Services (SIS) or Trust Funds (TF). The procedures for requesting technical assistance were presented.

6. The organization of the meeting was discussed and the programme for the week was distributed to the participants. This programme is attached as Annex II. The participants then presented the needs of their sectors regarding maintenance and CAD/CAM.

Mr. Lan Wenjin (China)

7. Mr. Lan is the Deputy Secretary-General of the China Association of Plant Engineering, which embraces various industries. This association is in charge of organizing the maintenance sector of different kinds of industry, mainly in the field(s) of training and international exchanges.

8. The Chinese government pays much attention to the maintenance problem in general and to national regulations concerning control management and maintenance of machineries, installation and other assets in industries in particular. Mr. Lan was particularly interested in new techniques in maintenance management (development of their own software), preventive maintenance (condition monitoring system) and repair techniques (metal spraying and brush-plating techniques).

Mr. Djanun (Indonesia)

9. Mr. Djanun is Head of the Manufacturing Technology Division in the Metal Industry Development Centre, which is part of the Ministry of Industry. This division supervises the development and improvement of all the processes involved in heat treatment welding, foundry, machine shop, metrology and metal laboratory. The maintenance problem is present in each programme. This centre is receiving much assistance from Japan, particularly in CAD/CAM facilities.

10. Mr. Djanun's preoccupation regarding this meeting was how to approach the problem of introducting the importance of maintenance into the metal-working industry.

Mr. Shani (Iran)

11. Mr. Shani is Head of the Computer Unit in the Iran Tractor Company, which is located in Tabriz. His interest in this meeting not only lies in the introduction of maintenance procedures through his computer unit, the introduction of software in production control, inventory control, maintenance system, but also in the discussion with experts on ways to approach the problem of maintenance in general in Iran.

Mr. Arunga (Kenya)

12. Mr. Arunga is Director of the Kenya Industrial Research and Development Institute (KIRDI), which is covered by the Ministry of Science, Research and Technology. This institute supposedly entails everything in manufacturing: project studies and development (economic studies), product and process development, engineering and design, analytical testing and consultancy. KIRDI would like to concentrate one part of the activities on maintenance

problems and to develop capabilities in repair and maintenance. The first step would be to educate people on maintenance in general as there have been no maintenance national systems and programmes up to now.

Mr. Quynh (Vietnam)

13. Mr. Quynh is Director of the Institute of Research and Development in Electronics and Informatics. This centre mainly trains people and provides experts. One of the goals of this centre is to support the introduction of CAD/CAM in industry, particularly in the field of maintenance.

14. Some presentations on the maintenance situations described by participants from the represented developing countries are found in Annexes III, IV, V and VI.

III. ORGANIZATION OF THE MEETING

15. The meeting consisted of morning sessions, during which organized guided tours in the international exhibition and visits of factories in Norway took place. Technical presentations and direct contacts among experts were arranged during the afternoon sessions.

IV. TECHNICAL PRESENTATION AND VISITS

Computer control factory system: the study of INDULOG

16. INDULOG is an engineering-software concept for the transfer of know-how based on the idea that complex machinery and plant systems can be operated more surely and economically with concise and easily convertible information made available "on the shop floor". This concept is an interface between the man and the machine. It allows constant access to background information on a specific machine, a process or facts. This colour-graphic software facilitates decision-making and the transfer of manufacture know-how and experience of users.

Condition monitoring: example of a bearing analyser

(Presentation made by Shocks Pulse Methods - SPM)

17. In a situation where downtime is increasingly expensive, the pressure is on the maintenance department in all industries. They must work on a just-in-time basis and replace failing components with the least possible

interruption of the production process. Therefore, the role of preventive maintenance continuously becomes more important. A condition monitoring system is based on modern technologies to establish these preventive maintenance actions.

18. The equipments presented by SPM are used in different kinds of industry, which are as follows:

a. Measures bearing damage;
b. Analyses lubrification condition;
c. Stores input data and readings;
d. Downloads readings to printer;
e. Interfaces with IBM-compatible PC.

All of this detailed, condition information helps maintenance personnel to prevent premature failures. Existing bearing damage cannot be reversed; however, its early detection reduces the risk of breakdowns. It also gives maintenance the opportunity to plan the replacement and reduce the necessary downtime.

19. The bearing analyser is based on the shock patters analysis as a function of the rolling speed, geometry and surface roughness. The shock level varies with the thickness of the oil film. Shock values could be translated to a measurement of oil-film thickness.

Tofte factory visit and its maintenance organization

20. This factory is one of the large and more advanced plants for the production of pulp in the world (capacity of about 300,000 tons/year, potential of about 350,000 tons/year) with 497 employees. Tofte produces semi-bleached and fully bleached kraft pulp. (Seventy per cent of the total production is exported.) Tofte has three paper mills: the Hurum Paper Mill (30,000 tons/year), the Sande Paper Mill A/S (80,000 tons/year) and the Sarpsborg Paper Mill (30,000 tons/year).

21. In the pulp factory, the main departments are woodyard, two continuous digesters (for chips and sawdust), two bleaching plants and three drying machines, chemical recovery plant, steam and power plant and production plants for chlorine/alkali and chlorine dioxide. The pulp mill is operating according to a plan, which permits 365 production days per year Such an arrangement necessitates a size-shift operation. The paper mill operates on a five-shift schedule.

22. In such a factory, a lot of attention is directed toward maintenance to avoid dramatic breakdowns, as well as toward training to be able to cope with the very sophisticated control and production equipment. The maintenance division falls under the Technical Section and is organized in mechanical maintenance, electrical/instrumental maintenance and civil engineering maintenance and is permanently in relation to all sections in the factory.

Eletrisk Bureau (EB) company visit: EB national transformer

23. With Asea Brown Boveri, EB has been assigned the global responsibility for hydropower development. In the field of electrical power, the product

range includes generators, transformers, medium voltage, switch gear, relay panels and monitoring and control systems.

24. During the visit of this very modern factory, particular attention was focused on the CAD/CAM Unit. A demonstration was performed on the automatic (or semi-automatic) process from the computer-aided design of a drawing to the workshop where metal is cut by a Computer Numerical Control machine, which is operated by punched cards of the CAD/CAM system.

Guided tour of the exhibition

25. The guided tour encompassed visits to many stands and special sessions, which were organized for the participating developing countries. These stands contained computer-systems communication equipment, computers for troubleshooting, control and regulation maintenance, control of internal environment, electrical maintenance, crack indication instruments, mechanical maintenance, oil analysis, planning and preventive maintenance.

Personal contacts among experts

26. In consideration for the needs of each of the participants from developing countries, experts from the exhibition reserved time to discuss specific problems.

V. RECOMMENDATIONS

27. Based on all discussions held with the experts from developing countries, project proposals will be elaborated in this manner:

China

a. Organization of a study tour to develop new, high-maintenance technologies in maintenance management, preventive maintenance (with condition monitoring) and repair activities (metal spraying, brush-plating techniques, etc.);

b. Development of Chinese software in the field of maintenance;

c. Development of South-South co-operation between China and other developing countries in the field of CAD/CAM and maintenance;

Indonesia

d. Realization of the importance of maintenance activities, particularly in the metal-working industry;

e. Introduction of Electronics Maintenance System;

Iran

f. Assistance in defining software packages for production control, inventory control and maintenance system;

g. Organization of a seminar in Iran for information on reconditioning and rehabilitation methods in industry;

Kenya

h. Establishment of national maintenance regulations;

i. Establishment of Engineering Development and Services Centre;

Vietnam

j. Establishment of a training centre in CAD/CAM and electronics services in tropical conditions.

VI. CLOSING SESSION

26. During the closing session, the participants spoke about the impact they received from this meeting. They found this meeting extremely useful and they appreciated very much the technical exchanges acquired from the organized activities. This exposure enabled them to further appreciate the importance of maintenance and CAD/CAM in industry and its relations to economic and industrial development.

27. UNIDO's representatives expressed their thanks to the participating developing countries for their dynamic participation and to the Norwegian hosts for their reception and hospitality. They underlined the scope of technical co-operation, which has been enlarged, between these five participating countries and UNIDO in maintenance and CAD/CAM.

ANNEX I

List of participants

China

Mr. Lan Wenjin, Deputy Secretary-General, China Association of Plant Engineering, and Professor, China Research and Education Center of Plant Engineering, 38, Yue Tan Nan Jie, Beijing

Indonesia

Mr. Aslam B. Djanun, Metal Industry Development Center, Ministry of Industry, JL. Sangkuriang 12, Bandung 40135

Iran

Mr. Morteza Shani, Iran Tractor MFG Company, P.O. Box 687, Tabriz

Kenya

Dr. R.O. Arunga, Director, Kenya Industrial Research and Development Institute (KIRDI), Dunga Road, P.O. Box 30650, Nairobi

Vietnam

Professor Dr. Hab. Nguyen Xuan Quynh, Director, Institute of Research--Development in Electronics and Informatics, 156A Quan Thanh, Hanoi, S.R.

Attending consultant

Norway

Mr. Bjorn Johannessen, Managing Director, Tero Management Consulting A/S (TMC), and President of EFNMS, Anchersensvei 13, 3000 Drammen

United Nations System

Two representatives of UNIDO participated in this meeting.

ANNEX II

Agenda

First day, Sunday, 12 March 1989

Presentation of UNIDO's activities		(09:00)
1.	Presentation by the participants of their sectors' needs regarding maintenance and CAD/CAM	
2.	Registration of suitable factory visits and appropriate contacts with Norwegian experts	
3.	General discussion	
4.	LUNCH RECESS	
5.	Visit to Holemkollen and Vikingship museums	(13:30)

Second day, Monday, 13 March 1989

1.	Opening ceremony of MAINTENANCE 89	(11:00)
2.	Maintenance Importance and Costs within Onshore Industry	(11:15)
3.	Maintenance Importance and Costs within the Transport Sector	(11:45)
4.	LUNCH RECESS	
5.	Expert Group Meeting	(14-17:00)
6.	Conference attendance or making direct contacts with Norwegian or other international experts regarding the needs registered on Sunday	
7.	Congress Dinner	(20:00)

Third day, Tuesday, 14 March 1989

1. Travel to Tofte Industries; factory visit with presentation of their maintenance management procedures (08:00)

2. LUNCH RECESS

3. Conference attendance or making direct contacts arranged with Norwegian or other international experts (15-17:00)

4. Dinner invitation by the attending consultant and his wife, Mr. and Mrs. B. Johannessen (19:30)

Fourth day, Wednesday, 15 March 1989

1. Guided tour to the Exhibition (09:00)

2. LUNCH RECESS

3. Direct contacts arranged with Norwegian or other international experts (13-16:00)

Fifth day, Thursday, 16 March 1989

1. Factory visits regarding the needs registered during the two first days (08-12:00)

2. LUNCH RECESS

3. Meeting with NORAD (14-16:00)

Sixth day, Friday, 17 March 1989

1. Bilateral contacts and closing session of the meeting--synthesis of work (09-12:00)

2. Free afternoon

ANNEX III

The Maintenance Situation in the People's Republic of China

Prepared by Lan Wenjin

The Chinese government is attentive to the plant engineering and maintenance management. In 1987, the State Council issued regulations on control management and maintenance of machineries, installations and other assets in industries. Government bodies and industrial enterprises in China should arrange their maintenance-management work according to the regulations. The regulations clearly point out the responsibilities of the government bodies and enterprises in the field of maintenance.

Since the early 1950s, China has established maintenance systems in enterprises on a comprehensive-maintenance basis. There are various types of maintenance organizations in Chinese enterprises. Maintenance works are arranged weekly and monthly; each year enterprises deliver an annual report describing their maintenance work. In the repair shops, various repair techniques are used to restore parts and machineries. Enterprises have also collected drawings, consumption data and spare-parts management.

China has experience in helping organize operators to keep the machinery they use in good condition and to perform daily routine work themselves. The production group cares for the routine work of all machinery in the group. This country does feel that it has had good results.

China's reform has been going on for a decade. In these ten years, there has been a greater opportunity to make exchanges with other countries in the field of maintenance. Also, from the view of technological development in industrial installations and machineries, it is very important to update maintenance management and meet the need of technological development. Thus, we have organized trsining programmes in terotechnology, condition monitoring, computer-aid maintenance, etc. Recently many maintenance engineers have used the concept of terotechnology and factories have gained experience in using the condition-monitoring technique in their preventive maintenance practice. In addition, software for maintenance management has been developed.

Co-operation with developed countries--especially in training--is imperative for China. This country needs to acquire advanced management and maintenance techniques from developed countries to raise the level of maintenance.

China also desires to have the function of South-South co-operation. The experience gained from this relationship may meet the needs of other developing countries, such as various repair techniques and other management methods. The chance to co-operate with other developing countries is very much welcomed.

The China Research and Education Center of Plant Engineering has been established to educate and train engineers and managers of different levels in China. This Center hopes to co-operate with other countries and wishes to received support from UNIDO.

ANNEX IV

Maintenance Aspects Pertaining to Engineering Industries in Indonesia

Prepared by Aslam B. Djanun

INTRODUCTION

Maintenance of production equipment is one of the aspects, which has to be taken into account in the development of engineering industry. It was found that the manufacturing technology development could give satisfaction if the industry is capable to maintain their equipment. By implementing proper maintenance and maintenance management, engineering industries could keep their equipment in operation with good condition and quality. As an enterprise usually pursues economic aims; that is, it attempts to make a profit, every piece of equipment can only be employed in these attempts when it is operating. Therefore, one must place great value on minimizing breakdown periods and periods of reduced performance. The engineering industry is equipped with various machineries, which require proper maintenance. These equipments should be kept in the condition where it is able to properly produce parts and machinery.

Since maintenance work incurs cost, in which lies the problem of cost reduction, these expenditures must be examined as to their magnitude and nature to be able to judge where and to what extent any effort to achieve this aim is worthwhile. This is why the introduction of maintenance to the engineering industry will be an activity of the Metal and Machinery Industry Development Centre.

PRESENT SITUATION

Maintenance in industry

Presently, Indonesia is approaching the end of the Fourth Five Year Development Plan (Pelita IV, 1984-1989). The Fifth Five Year Plan will start on 1 April 1989. In this period priority will be given to the development of industry simultaneously with strong agricultural development. The Government has spread the industry throughout the country and in this Fifth Five Year Plan, the engineering industry must be able to produce more industry machinery and equipment to meet the increasing domestic and export demands.

Industry is classified accordingly: basic, multifarious and small-scale industries. Those industries cover various products or commodities such as oil, mining products, forestry, plywood, textiles, manufacturing, machinery, metals, chemical industries (cement, fertilizers) and agro-industry (palm oil, tea, rubber, coffee).

As far as maintenance is concerned, most of those industries do not fully implement the maintenance system, except for the big, strategic industries. They only recognize maintenance as corrective maintenance or repair. The level of maintenance in Indonesian factories, particularly the nonprocess-type installations, is characterized by the breakdown maintenance mode.

Only a few of them implement planned maintenance with a complete historical record and preventive-maintenance programme. Fertilizer factories and oil refineries are implementing planned maintenance and have been supported by proper maintenance management. They organized maintenance to have periodic overhauls during the year. For example, the palm-oil industry and sugar mills overhaul the equipment during the low season and have all equipment available during the high season.

In the engineering industry, not more than 25 per cent apply preventive maintenance. Maintenance is performed only when there is apparent machinery trouble. The management does not realize that improper maintenance will affect production, which in turn will affect delivery time and quality. Management is unaware that poor maintenance will increase production cost as only few machinery industries can be convinced of the relationship between production cost and accounting or financial aspects. Some industries have general records of maintenance costs; however, they have not analyzed these records. Therefore, it was impossible to go further with such records.

The qualifications and skills of maintenance personnel are generally insufficient. Improvement and training are also required. Most of the personnel are mechanics, who can repair and oil. They are not skilled enough in hydraulics and electronics; it is rare to find someone who knows better maintenance management. Because its machinery equipment is imported, the spare-parts industry is facing many problems. It is difficult to receive spare parts in due time and at reasonable prices.

Maintenance in the Metal Industry Development Center (MIDC)

The main role of this institute is to develop the metalworking industry. Quality improvement and production increase are the developmental goals, which can be achieved by improving technological capabilities of industry, one of which is maintenance. To render the development activities, the institute is provided with facilities similar to the machinery of the metalworking industry. With this equipment, MIDC can produce parts, components and prototypes as part of an experiment. Therefore, the job of MIDC is different from that of the metalworking industry. MIDC is not a production unit; MIDC is an experimental unit. The institute is provided with foundry equipment, machine tools, welding equipment, heat-treatment facilities, a metrology room, a chemical laboratory, mechanical-test equipment, nondestructive test equipment, a sand laboratory and various kinds of cutting tools. The age of equipment ranges from one year to seventeen years of use.

To provide proper maintenance systems to those facilities requiring them, MIDC tries to establish suitable ones and to correctly maintain the equipment. MIDC incorporates a step-by-step improvement of maintenance

capabilities. To start a maintenance programme, it is necessary to have complete data on the equipment. Usually, it is with luck that equipment is received with a complete instruction and maintenance manual. MIDC had to recruit and train people to handle maintenance. From the beginning MIDC implemented preventive maintenance. After a five-year operation period, the equipment increased in number and sophistication. MIDC faced many problems and felt that the maintenance staff should also be increased.

MIDC develops industry, particularly the metalworking industry, by providing assistance and training to the recipient industry, including training on maintenance. This experience has convinced MIDC to offer more service to industry and introduce the implementation of preventive maintenance. As a start, MIDC set up a computer system in maintenance and prepared software.

MIDC's effort could achieve the following conditions:

a. Daily inspection of equipment/machinery done by the machine operator;

b. Preventive maintenance is executed; schedule of oiling is available and done by maintenance people;

c. Knowledge of electronics improved;

d. Minor repair of electrical hydraulic and rewind electrical motor can be done;

e. Mechanical adjustment and repair can be executed;

f. Codefication had been given for equipment and spare parts;

g. History record card was completed;

h. MIDC has the capacity to test the characteristics of machine tools and rehabilitate machine tools.

CAD/CAM situation

The effective use of Computer Aided Design and Drafting (CADD) in Indonesia was started in 1983 by a few companies and increased significantly in 1986. As of 1989, about 15 companies are using CADD excluding government bodies and universities.

Two of these fifteen companies are working on a main-frame base. The remaining ones function on a work-station or PC base. Most of those companies expressed that they need a long time to consider before deciding on the CAD application in their own companies, although in most cases computers (PCs) were mostly used for management purposes.

The mutual background of the companies in applying CADD was productivity of the design (covering all steps) starting with 2D or 3D modeling up to detailed drafting. A consulting company, which uses a work-station-base CAD,

states that it needed two years to fully acquaint itself with the multidisciplinary design system. Another company claimed a five-to-six month learning curve for drafting in order to reach the same productivity as done manually. However, there was, afterwards, a significant improvement in productivity--up to 400 per cent!

The application of CAM is still limited to a few big companies, namely IPTN (aircraft industry) and PAL (shipbuilding). The significant steps to be taken for the application of CAD/CAM are:

a. Economic justification, which could differ by terms (aims, area of application, job demand);

b. Selection of appropriate hardware/software with the current and future jobs;

c. Training of personnel, which may consist of two stages, namely:

i. training to acquaint oneself with the function of the hardware/software abilities;

ii. on-the-job training aiming for mastering the entire system by doing the real job. (In this stage, personnel will develop the optimum capability in using softwares.)

d. Management aspects

i. standardization of codes or symbols intended for use and file titles;

ii. organization and job descriptions;

iii. established discipline in job execution;

iv. maintenance of the hardware.

CONCLUSION

All sectors of industry are aware of the necessity of maintenance; however, the implementation has been improper, especially in organized big- and strategic-industry maintenance, which is primarily based on preventive and systematic maintenance. The majority of problems they are facing are in managerial management. These problems were not studied and analyzed from the economical point of view. Some of the industry does not also have the know-how and skilled staff for doing maintenance, including technical know-how.

The Government of Indonesia has accorded a high priority to the improvement of non-oil and gas exports, particularly exports of manufactures. To support the export effort, it is essential that optimal use of capital plant and equipment should be made and plant outages and costly repair be reduced.

The promotion and institution of preventive maintenance is considered to be a priority requirement for the optimal condition of the equipment. The systematic introduction and expansion of preventive maintenance activities can also be a conductive factor for ensuring product quality and adherence to delivery schedules.

The level of maintenance in Indonesian factories, particularly the [illegible]process-type installations, is characterized by breakdown maintenance mode. Inadequacies in routine preventive maintenance can be found in most plants. Primarily, the importance of systematic preventive and predictive maintenance is not appreciated by senior management: maintenance is often viewed as a repair function.

The application of CAD/CAM is still limited to a few large companies, particularly in the engineering industry, which cope with sophisticated and export-oriented products.

ANNEX V

Iran Industries

Prepared by Morteza Shani

INTRODUCTION

Iran is a large country and has rich sources of industrial and agricultural materials. Iran is an oil producer and wells of oil can be found all over the country. According to experts, Iran has a vast source of iron, which can easily be used by any steel plant.

Although all Iranian sources are not as easily accessible as those of the United States (oil is not at a depth of 80m and gold is not found at river banks), the materials from all sources can be extracted rather easily by effort and use of modern machinery. Some of these sources cannot be found elsewhere in the world. From the oil well near the city of Ghom" erupts some 50,000 barrels of oil daily. This kind of oil well with such a pressure cannot be found elsewhere. Coal is extracted from high-quality "kerman"-rich mines. Limestone, which is the main element in the cement industry, and other kinds of ore used by chemical industries are available in large quantities.

The above-mentioned sources are the cornerstone of Iran industries. In other words, Iran has vast raw-material sources for industrial development. Presently, the only snag in development is the shortage of skilled and trained manpower. At this juncture, knowledge, technique and skill are important factors for any development. There are nations who have rich sources of raw materials cannot achieve any goals due to the lack of technique and skill.

Iran urgently needs to seek modern techniques and high-professional experts. The lack of highly-trained personnel has made Iranian industry appear uncompetitive. However, an explicit effort has been exerted to accelerate the momentum of introducing new measures. All small business is directed toward new techniques and large investments are changing the contour of heavy industries.

STRUCTURE OF IRAN INDUSTRIES

Iranian industries are playing a major role in the framework of the economy. Statistics show that there are 50 million people in Iran. Thirteen million of this total population are considered to be the most active sector used by industries.

Three ministries control all the industries scattered around the country. The Ministry of Heavy Industries is responsible for the machine-tools plants, tractor-manufacturing plants and car making plants.

All heavy industries have been developed with the aim to exterminate the mono-economic system. Now most of the revenue is provided through oil export. By having heavy industries, Iran will enjoy and gain more space to manouver in its economy. Although most heavy industries seem to be uncompetitive in the open market and cannot stand along with industries of advanced countries, there is a trend to support as much as possible the quality of goods while optimizing the cost.

Cost optimization is gained by employing modern technology in production lines such as NC, CNC machines or other automatic lines.

The productivity of automatic lines can be guaranteed if the right effort is pushed by computer.

The computer and its gains have caused a fabulous and revolutionary economic change, including heavy industry. Nowadays, linear developments have been abandoned; all decision makers want to use the computer-controlled system, which enables them to achieve high-quality, low-cost goals.

After the Islamic Revolution a gap was created by factors originated by this specific situation. Decisive steps have been taken to improve it and, eventually, bridge the gap. Fortunately, success in the field of informatics has initiated the substitution of old-verion computers. Old-version computers, which constitute the backbone of the present system, are IBM (370 family), UNIVAC and Honeywell. The trend in the new computerization can be categorized in three classes.

A. Microcomputer

The low-priced microsystem has encouraged most managers to take advantage of the PC system in their environment. IBM PC/XT is presently the dominant version, although other models such as AMSTRAD, ATARI, and COMMODOR are found to be hobby tools.

B. Minicomputer

In the early 1970s, minicomputers were introduced to Iran. Most of the firms preferred to purchase minicomputers rather than the more sophisticated IBM system, Data General Model Ecillips 300 and CMC, which were dominant minicomputers. Now some of those minis can be found operating, although they are more expensive to use. The maintenance of these computers has forced authorities to seek other alternatives.

C. Main frame

Before the revolution, Iran possessed some main frames, including IBM 370/158. However, due to the rapid, world development of main frame, it is inevitable to lean toward the new main system. Due to United States-imposed sanctions, it is rather impossible to provide bran new IBM main systems. To meet the demands of the main-frame system, Japanese computers called "BASF" were purchased from West Germany. Since BASF was too expensive to purchase, there has been a tendency to buy--through a third party--a main frame from the IBM 4300 family. Eight units of IBM 4300 have been purchased with respective softwares.

Employing main frames in eligible heavy industries and using mechanized systems will enable industries to perform production control, capacity planning, bills of material and, finally, CAD/CAM/CAE by a well-organized computer network. Finally, it is worth mentioning that in the past five years, Iran has achieved an impressive development. Its success in the field of computer-based industries has attracted attention and its expanding economy now offers attractive incentives to businessmen of other countries.

ANNEX V

The Situation of Applying Microcomputers for Industrial Management and CAD/CAM in Vietnam

Prepared by Nguyen Xuan Quyhn

GENERAL SITUATION

After a long period of war, the electronic and informatic industry, like other industries in Vietnam, still remains on a very low level. One can, therefore, say that there is not an electronic industry in Vietnam yet and there is not any industry of producing microcomputers and other informatic equipments for requirements of our country. All computers now used in Vietnam have been imported. The number of computers in Vietnam is very small; in fact, there are about 2,000. Many of these came from Western countries, for example, like the IBM PC/XY/AT and PS/2.

There are about 1,000 informatic engineers, which is a small number as well. These engineers have received their education in Vietnam and in different countries. Presently, students in the informatic profession may be educated in four universities and two institutes. In Vietnam, there is support for informatic education centers for business management and industrial management. On the other hand, the Vietnamese people have many capacities for work and activity in this profession.

APPLICATION OF COMPUTERS IN INDUSTRIAL PRODUCTION IN VIETNAM

Some years ago Vietnam has begun to use microcomputers in industries in the following fields:

a. Microcomputers are supplied with automatic control systems of production processes, which have been imported, for example, by the Government from different countries. Such imports include, for example: automatic control systems in the textile industry, food-processing factories and medicine-equipment factories;

b. Microcomputers are used in management at factories, state organs and government bodies. There are financial, planning, manpower, payment and material managements. These initial microcomputer-application steps bring a high economic efficiency to Vietnam;

c. Although it is only a beginning, microcomputers are also employed for designing, for example carpet-model designing.

PROPOSALS FOR CO-OPERATION WITH THE OTHER COUNTRIES AND INTERNATIONAL ORGANS

The Vietnam Institute of Research and Development in Electronics and Informatics is the official organ commissioned by the Vietnamese government to study computer application in industrial and business management. Therefore, the co-operation of other countries in establishing the following centers at this Institute would be appreciated:

a. The education center of informatic engineers, specially in CAD/CAM learning;

b. The information-education center for directors of industrial factories;

c. The computer-service center for assemblying microcomputers for requirements in Vietnam and computer hardware and software services.

The Vietnamese government has proclaimed a law of invest capital and provides a new opening policy. Therefore, co-operation, materializing in different forms, will be useful for us all.

The Government has decided to organize an International Exposition on Computers in Engineering and Education, which will convene in Hanoi from 23 to 27 October 1989. The Exposition Committee respectfully invites you to participate in this event. Your presence and your company's products are requested and should surely make this International Exposition interesting and abundant.

The Vietnam Institute of Research and Development in Electronics and Informatics would like to greet you respectfully and expects to have the honour to welcome you to the special capital city of Hanoi.