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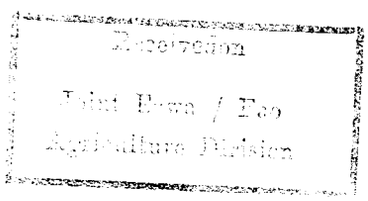
Expert Group Meeting on
Automation and Microprocessor Controls
15-17 November 1993
Amman

FINAL REPORT



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Introduction

A. THE IMPORTANCE OF AUTOMATION AND MICROPROCESSOR-BASED CONTROLS

1. In a modern factory, a well-designed and properly maintained/operated process control and instrumentation system is the key to product quality and plant productivity. On the other hand, the lack or malfunctioning of a process control system can have an immensely negative impact on all aspects of plant operation.

2. Many industrial plants in developing countries have been erected as a result of cooperation and/or technology transfer arrangements with foreign companies based in industrialized countries. Therefore, even plants within the same industrial sector/subsector might have been designed by using greatly varied process control system design philosophies, and equipped with different instrumentation. It is very difficult not only to use, but also to repair and maintain such a large and diverse collection of instruments.

3. The magnitude of the problem can be better understood if one considers that the cost of control equipment and systems can amount to as high as 25 per cent of the total fixed capital investment. Therefore, savings can be achieved not only by keeping the existing process control systems fully operational—and hence allowing for the more efficient utilization of present productive capacity—but also through the optimum selection and/or design of process control systems for the new capacity to be created.

4. The instruments used in industrial controls are considered special within the realm of instrumentation. The development of instrumentation techniques in a country is a necessary condition for overall technical/technological development. The rapid industrialization of several developing countries over the last years/decades has resulted in an even more rapid increase in the use of measuring and control instrumentation. The penetration of instruments into such areas and institutions as industrial process controls, telecommunications, research and development, testing laboratories, universities, meteorology centres, agriculture, public health, education and services has been significant. The efficient use of national instrumentation resources is not only necessary for the viable operation of existing systems, but also constitutes a prerequisite for technical, industrial and economic development.

5. Modern instrument design is based on microprocessors which are embedded within the instrument to both control the measurement functions and make on-line analyses of measurement results, and which may also provide instructions for rectification for process actuator. Further, automating individual instruments leads itself to fully automated test systems, which are capable of continuous and high-speed measurements.

6. Efficiency in the use of instrumentation resources at the institutional/company, sectoral, and sometimes national levels in a developing country cannot be achieved unless the following basic conditions are met:

(a) The existence of well-designed, -coordinated and -implemented instrument-acquisition policies which cover, *inter alia*, planning, specification, selection and purchasing;

(b) The availability of an institutional framework(s) which provide(s) for the maximum utilization of available instruments (calibration services, repair and maintenance services, renting, and operator/technician training).

B. MICROPROCESSOR APPLICATIONS IN THE ARAB COUNTRIES

7. Microprocessor-based controls and instrumentation are being introduced haphazardly in most large industries in the Economic and Social Commission for Western Asia (ESCWA) region (e.g., for petroleum extraction and distribution, refineries, petrochemicals, chemicals, cement, phosphate, power generation and distribution), as well as in newly established automated production systems. Most of the time, these controls are introduced as integral parts of newly installed turnkey projects, where end-users are not fully aware of their capabilities and limitations. End-users generally do not include their preferences or specifications for certain types of controls in the project contract, leaving the decision to the turnkey contractors. The way in which these controls and systems are currently being introduced has resulted in many operation and maintenance difficulties, the most significant among which are that specifications are not always suited to local conditions, and that no serious preparation of the operation and management personnel is being undertaken.

8. Earlier ESCWA and United Nations Industrial Development Organization (UNIDO) missions to selected Arab countries revealed that many of the installed systems were causing frequent delays and work stoppages, mainly due to the lack of qualified personnel capable of properly operating and maintaining the advanced controls and instrumentation. In a meeting jointly organized by ESCWA and UNIDO in 1985, an important recommendation called on both agencies to assist in the establishment of a regional centre for the design, training and maintenance of microprocessor-based controls, systems and instrumentation. Furthermore, the Syrian Government recently expressed serious interest in housing and supporting the establishment of such a regional centre, whose objectives would include the following:

(a) To rationalize the diffusion of microprocessor-based applications and to harmonize their selection, operation and maintenance in the region; this would include the possibility of preparing standards/harmonized guidelines and specifications;

(b) To help boost technical capabilities in the region, by training trainers and setting up the infrastructure to maintain these systems;

(c) To improve the operational life cycle of installed systems and to reduce delays and work stoppages in production projects using these systems, thus enhancing the economic productivity of these projects.

9. An important objective of this Expert Group Meeting is to deliberate on the current situation prevailing in various Arab countries relating to the diffusion and exploitation of microprocessor applications, and to formulate tangible action-oriented recommendations to improve these conditions (the later objective includes consideration of the profitability and feasibility of establishing a regional centre, as described above).

I. ORGANIZATION OF THE MEETING

A. OBJECTIVES

10. The objectives of the Meeting were as follows:

(a) To deliberate on the diffusion and operation of electronics instrumentation and microprocessor controls in the Arab countries;

(b) To enhance the technical capabilities of the Arab countries to install, operate and maintain the latest automation instrumentation and microprocessor controls;

(c) To study the necessity and feasibility of establishing a regional instrumentation service centre in one of the countries of the region.

B. ORGANIZATION

11. The Meeting was organized by UNIDO and ESCWA, and hosted by the Faculty of Engineering and Technology[1] at the University of Jordan from 15 to 17 November 1993. The Meeting's organization of work is provided in annex I to the present Report.

C. PARTICIPANTS

12. The Meeting was open to all interested persons from academia and industry. About 25 attended, including six from outside Jordan. A list of participants appears in annex II to the present Report.

D. WORK SESSIONS

13. The Meeting was divided into work sessions centred around the topics presented. There were two background presentations given by UNIDO experts—one on industrial automation and developing countries; and the other on instrumentation issues. The ESCWA secretariat presented a paper on microprocessor controls and instrumentation in the ESCWA region. There were also four country papers from Jordan, Lebanon, the Syrian Arab Republic and the Gaza Strip.

Finally, one paper was presented by the Syrian Atomic Energy Commission on the need to establish a regional centre for instrumentation repairs and services. The list of papers presented appears in annex III to the present Report.

The Meeting deliberated on the various issues and problems presented in the working papers. Discussed at length were the need for and benefits of a regional or subregional centre for instrumentation.

II. RECOMMENDATIONS

After deliberating on all papers presented and other related issues, the Meeting adopted the following recommendations:

14. Automation and process control

(a) To encourage Governments in the region to formulate policies relating to industrial automation, and to support the automation efforts undertaken within these countries. Government actions should be based on surveys to be undertaken as soon as possible and regularly updated;

(b) To organize support—from universities, research centres, relevant government agencies—for industrial enterprises and other firms concerned with industrial automation, especially in aspects of management and operation restructuring and in the selection of appropriate automation systems or modules suited to the immediate needs of enterprises planning to apply automation;

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[1] The Meeting was partially financed by a French contribution to the ESCWA programme on microelectronics.

(c) To support existing automation and process control laboratories and centres, and to encourage the establishment of such centres in countries planning to introduce automation;

(d) To promote cooperation between automation laboratories and centres, starting with the implementation of a joint process control pilot project, but eventually aiming at developing a more systematic mechanism of cooperation;

(e) To promote the creation and support the operation of industry cooperative programmes in the region—i.e., to facilitate joint training, machine-sharing and consultancy exchange.

15. Instrumentation service centres

(a) To promote the establishment of new—or to strengthen existing—instrumentation service centres in every country of the region involved in automation. The instrumentation services would cover, *inter alia*, the training of operators and maintenance personnel; repair and maintenance; the establishment of instrument databases; consulting; calibration and standardization; the design and development of special instrumentation systems; and the development and/or modification of related software;

(b) To promote and strongly support the establishment of a regional instrumentation repair and service centre which would be linked to other centres in member countries and would provide a high level of services and undertake joint training activities, specialized maintenance and consultancy tasks;

(c) To promote the creation and support the operation of a network of microprocessor applications and instrumentation service centres within the region. Such a network could be built around the proposed regional centre, with participating instrumentation service centres and facilities to be set up in member countries.

16. Training

(a) To organize training programmes covering the basic skills related to instrumentation: microprocessor applications and related software, mechanics, fine mechanisms, hydraulics, pneumatics, electromechanics, electronics and glass-blowing;

(b) To organize specialized training programmes in fields related to automation and digital process control, and to the repair and maintenance of environmental monitoring equipment, biomedical instruments and microprocessor-based instruments;

(c) To promote the application of interactive computer-aided instruction (CAI) packages for the training of instrument operators and repair personnel.

17. University-industry cooperation

(a) To encourage universities and other educational institutions in the region to undertake the following tasks (and to support these endeavours as necessary):

(i) Carrying out industrial surveys;

(ii) Organizing specialized training courses for industry;

(iii) Providing consulting services to industry;

(iv) Arranging continuing education for engineers, foremen and other skilled personnel working in industry.

(b) To encourage universities and other higher-education institutions in the region to release their staff members for fixed-time leaves to enter industry under a "faculty development plan", and to encourage industrial firms to participate in such activities by hosting faculty members and involving them in serious industrial activities in their factories and workshops.

18. Manufacturing

(a) To make use of already completed feasibility studies which have indicated the existence of a large regional market for electronics equipment and instrumentation; to investigate the feasibility of manufacturing electronic parts and equipment—particularly control systems—in individual and/or regional groups of countries; and to organize activities related to investment promotion;

(b) To promote and support the design and development of microprocessor-based systems; and to promote the small- and medium-scale manufacturing of designs developed locally through technology incubators and other means;

(c) To increase the awareness of manufacturers in the region of quality concepts and techniques, with a view to attaining the quality management standards of ISO 9000. In this regard, ESCWA and UNIDO should organize awareness activities, addressing all those concerned with these standards (i.e., those in industry, academia and public administration).

19. Instrumentation data systems

(a) To assist the countries of the region in the creation of technical and technological microprocessor applications and instrumentation databases, and to help optimize the selection and purchase of instruments and other microprocessor-based systems;

(b) To assist in the creation of a regional database for skills in related areas;

(c) To promote and support the use of electronic data networks.

20. Continuous exchange of information

(a) To promote the exchange of information relating to automation, process control, and microprocessor applications and instrumentation among the countries of the region. One possible framework is the development of a network such as that referred to in recommendation 15(c);

(b) To conduct a comprehensive survey of the applications of automation and microprocessor controls in the region, with particular emphasis on industrial applications. This survey should constitute the first step in a series of activities aiming at the formulation of policies for the development of local and regional capabilities in automation and microprocessor control applications;

(c) To continue to organize meetings and other activities related to automation and microprocessor controls; in particular, greater effort should be exerted to secure full representation

from industry at the national, regional and interregional levels. These meetings and activities should promote, *inter alia*, cooperation with other developing countries in the various regions.

21. Providing support to private instrument-making and -servicing companies

(a) To support private companies designing, manufacturing and servicing instruments—and/or developing related software—through technical assistance projects and programmes which include the provision of equipment, expertise and training;

(b) To promote and support the design, development and small- and medium-scale manufacturing activities of new entrepreneurs through both technology incubators and other means (see recommendation 18[b]);

(c) To promote the local development of automation systems and related software which are both marketable in and appropriate for the industries of the region.

22. Cooperation

To promote cooperation among the countries of the region in relevant fields through the formulation and implementation of joint activities and through the implementation of the above-mentioned recommendations.

III. SUMMARY OF PRESENTATIONS

A. INDUSTRIAL AUTOMATION AND DEVELOPING COUNTRIES

23. This was the main working paper of the Meeting, presented and discussed in two sessions by Mr. Pablo Spinadel. It covered a wide range of topics, elaborating on the background of industrial automation issues and the problems and necessary actions involved in introducing it in developing countries. The paper was divided into five main sections:

(a) An introduction to industrial automation in a broad sense, with reference not only to related technologies, but also to methods and tools associated with the introduction of automation issues in industry;

(b) Issues related to infrastructural needs in developing countries *vis-à-vis* the introduction of industrial automation;

(c) A description of some of the possible excellence centres that could be used as important tools in introducing industrial automation in developing countries;

(d) Some of the elements relevant to developing countries with respect to the difficult process of introducing industrial automation—including organizational changes, the strategic networks and skills needed, the selection process of a new technology, the selection of equipment, and the relevance of microprocessors to industrial development;

(e) An explanatory guide of elements to be avoided, actions to be taken and studies to be done prior to the process of introducing industrial automation in developing countries.

B. Microprocessor controls and instrumentation in the ESCWA region

24. This paper, presented by the ESCWA secretariat, summarized the diffusion and utilization of instrumentation in the ESCWA region. Extending from the Arabian Gulf and the Arabian Sea to the shores of the Mediterranean, this region includes countries with varying levels of industrial system development and sophistication. The paper stated that while it was difficult to generalize observations for all countries and sectors, it was safe to say that microprocessor-based controls and instrumentation were being introduced at a growing rate in most large industries and services in the region (e.g., for petroleum extraction and distribution, refineries, petrochemicals, power generation and distribution). They were also being introduced, though at a slower pace, in newly established automated manufacturing systems. One general observation is that most of the time, end-users in the region were not aware of the type of controls introduced within their systems, or of their capabilities and limitations; end-users rarely included their preference for certain controls or specifications in turnkey project contracts. The ways in which these controls and systems had been introduced had resulted in many operational and maintenance difficulties. It was pointed out that the market for these controls was estimated at more than $1 billion per year—more than two thirds of which was for retrofit, repair and services. It was also pointed out that no serious effort had been made to develop the human skills necessary for coping with this large and expanding market.

25. The paper went on to describe Arab markets, the characteristics of the clients in these markets and the main end-users. It briefly summarized the manufacturing activities in the region, in electronics as a whole, and in instrumentation, and ended with a short description of the service, repair and training facilities available in the region for microprocessor applications and instrumentation.

C. UNIDO presentation: instrumentation issues

26. This paper, prepared by the UNIDO secretariat, briefly presented various issues related to instrumentation and automation in developing countries, as addressed by UNIDO. The paper described UNIDO's assistance to developing countries through technical cooperation projects, and also explained the steps and methodology to be undertaken by any one country concerned to benefit from this service. The presentation stressed that in the field of instrumentation, UNIDO was assisting in the establishment of many national and regional centres in developing countries which covered a wide range of services: purchase order specifications and validations; repair and maintenance; registration; renting and time-sharing; design, manufacturing and installation; training; and spare parts storage and/or substitutions. Finally, it was stressed that the ESCWA region ought to establish an excellence centre for instrumentation that would be able to provide any or all of the services described above. UNIDO activities in this area are presented in annex V to the present Report.

D. Automation and microprocessor controls and instrumentation in the Syrian Arab Republic

27. This country paper was presented by Mr. Sami Khiyami of the Higher Institute of Applied Science and Technology. The paper summarized the diffusion and utilization of instrumentation and microprocessor-controls in the Syrian Arab Republic. It stated that microprocessor-based controls and instrumentation were originally introduced in The Syrian Arab Republic as integral parts of newly installed turnkey projects. Actually, however, microprocessor-based technology had been made available much earlier (1979) in some research and development (R and D) and teaching laboratories, but had been confined to the development of certain prototypes, rarely reaching the manufacturing phase (except in some isolated cases). The influence of R and D on the proliferation of microprocessor-based controls and instrumentation was therefore insignificant in the 1980s.

28. The market demand for low-cost electronics systems, the shortages of hard currency and the re-emergence of the private sector have all played important roles in encouraging R and D institutions, some manufacturing plants and young entrepreneurs and engineers to be more involved in the development—and sometimes the small-scale manufacturing—of microprocessor-based equipment.

29. The paper traced the history and development of microprocessor-based controls and instrumentation in the Syrian Arab Republic, and indicated the current status of electronics manufacturing in the country, with an emphasis on the relationship between R and D and industry, and on the individual future plans for each sector. A case-study of a large Supervisory Control and Data Acquisition (SCADA) system for water dispatching in the city of Damascus was also described and commented upon.

E. The status of Lebanese industrial automation and lessons from the U.S. electronics manufacturing

30. This paper was presented by Mr. Fouad Mrad of the American University of Beirut. The first section of the paper briefly described the status of Lebanese industrial automation, with special emphasis on microprocessor applications; specifically reviewed was the status of automated production in typical manufacturing plants in Lebanon (namely, cement and paper and plastic products facilities). The paper also discussed a case-study related to a local electronics company, illustrating the difficulties and environment facing most struggling electronics trial industrial ventures in Lebanon.

31. The second section of the paper briefly presented an example of high-technology automated manufacturing in the United States of America for comparison. The paper reviewed the strategic steps taken to improve the American manufacturing infrastructure's present situation. The paper concluded with some recommendations and observations.

F. The industrial sector and automation in Gaza

32. The paper on the Gaza Strip was a very short description of the sad situation that has prevailed there since the 1967 occupation. After 1967, the industrial sector in Gaza became a subsidiary of the Israeli sector. New investments were severely restricted, and most industries closed down. A few training centres were allowed to operate but only in limited, traditional fields. Automation and microprocessor applications were a scarcity and a luxury. The paper ended by calling for all possible assistance to help remedy the prevailing situation.

G. A project to establish a regional centre for instrumentation repair and services

33. This paper was prepared by the Atomic Energy Commission of the Syrian Arab Republic and was presented by Mr. Ibrahim Haddad, the director-general of the Commission. The paper elaborated on the need to establish a high-level centre for instrumentation repair and services—a centre that could service many countries in the region, given the geographic proximity and the lack of such services in most of these countries. The paper concluded by giving a preliminary description of the centre's proposed objectives and structure. (The entire paper is reproduced in annex IV to the present Report).

Annex I

ORGANIZATION OF WORK

Monday, 15 November 1993

8.30 - 9.30 a.m. Registration

9.30 - 10 a.m. Opening session

10.30 a.m. - 12.30 p.m. Presentation of the main issues for discussion:

(1) " Industrial automation and developing countries", presented by UNIDO consultant, Mr. Pablo Spinadel;

(2) "Microprocessor controls and instrumentation in the ESCWA region", presented by the ESCWA secretariat.

2 - 3 p.m. Visits to laboratories at the University of Jordan (Computer Integrated Manufacturing [CIM] and Controls)

3 - 5 p.m. (1) A project to establish a regional centre for instrumentation repair and services, presented by Mr. Ibrahim Haddad of the Syrian Atomic Energy Commission.

(2) Country paper of the Syrian Arab Republic: "Automation and microprocessor controls and instrumentation in Syria", presented by Mr. Sami Khiyami of the Higher Institute of Applied Science and Technology.

Tuesday, 16 November 1993

9 - 10.30 a.m. Discussion of the main issues (continued), by Mr. Spinadel

11 a.m. - noon Country paper of Jordan: presented by Mr. Yusef Al-Assaf of the University of Jordan

Noon - 1 p.m. Visit to laboratories at the University of Jordan (Electronics)

2 - 4.30 p.m. (1) Country paper of Lebanon: "The status of Lebanese industrial automation and lessons from the U.S. electronics manufacturing", presented by Mr. Fouad Mrad of the American University of Beirut;

(2) Country paper on Gaza: "The industrial sector and automation in Gaza", presented by Mr. Halim H. El Halabi of the Development Resource Centre;

(3) "UNIDO presentation: instrumentation issues", presented by the UNIDO secretariat

Wednesday, 17 November 1993

9 - 11 a.m.	Formulation and adoption of the Meeting's recommendations
11 a.m. - 6.30 p.m.	Visit to the Jordan University of Science and Technology in Irbid

Annex II

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Annex III

LIST OF DOCUMENTS

1. "Industrial automation and developing countries", by Pablo Spinadel
2. "Microprocessor controls and instrumentation in the ESCWA region", by the ESCWA secretariat
3. "UNIDO presentation: instrumentation issues", by the UNIDO secretariat
4. "Automation and microprocessor controls and instrumentation in Syria", by Sami Khiyami
5. "The status of Lebanese industrial automation and lessons from the U.S. electronics manufacturing", by Fouad Mrad
6. "The industrial sector and automation in Gaza", by H. Halabi
7. "A project to establish a regional centre for instrumentation repair and services", by Ibrahim Haddad of the Syrian Atomic Energy Commission

Annex IV

PROJECT PROPOSAL FOR THE ESTABLISHMENT OF A REGIONAL CENTRE FOR INSTRUMENTATION REPAIR AND SERVICES

A. INTRODUCTION

The industrial revolution in Europe split the peoples and nations of the world, giving rise to "developed" and "developing" countries; the fate of the latter has been to endure the sociopolitical and economic repercussions of this revolution. Further, the advent of modern technologies encouraged the industrialized nations to enhance their dependence on research-oriented endeavours, eventually bringing about another revolution no less important than its predecessor—namely the far-reaching revolution in the field of electronics; the split between the developed and developing countries broadened as a result, and the possibility of bridging this gap in the foreseeable future is remote.

This new reality has placed the developing nations, including those in the Arab world, in a most tenuous situation where they have had very little choice but to try hard to catch up with the innovations of the new generation of rapidly changing technologies even before completely grasping the secrets of the old ones. This has progressively engendered further subordination, even at the level of operating and/or maintaining the newly acquired technology.

B. MODERN TECHNOLOGY: CHALLENGES AND PREDICAMENTS

If electronics has liberated the developed world and given it the ways and means to accelerate its progress, it has also unfortunately created a number of problems for developing countries, often constituting a liability rather than an asset for the latter. It is one thing to acquire new technologies, but quite another to handle them properly; what developing countries must concern themselves most with at this point are the problems related to the malfunction of acquired equipment, with a view to ensuring optimal utilization.

Electronic systems and circuits presently constitute the main basis for all types of modern and sensitive equipment—whether scientific, medical, industrial or nuclear. These systems have offered new potential in the realm of control, processing, automation and measurement, and have consequently helped to upgrade the accuracy, sensitivity and performance speed of equipment in general. Conversely, the delicate electronic components of these systems and circuits are the most vulnerable to failure, given their excessive sensitivity to surrounding variables and terms of operation. Furthermore, the manufacturing companies, as they develop successive generations, seek to minimize the life expectancy of the equipment—at times for technical reasons, but often for economic and purely commercial purposes. This trend is undoubtedly reflected in the investment in this equipment in both the developed and developing countries. The scientific and physical potential of industrially advanced countries and the nature of their presence on production sites make it possible for them to utilize the equipment in an optimal manner. Statistics indicate that developed countries earmark 5 per cent of their income for preventive maintenance services and repair, while developing countries lack both the scientific and financial means and capabilities (in addition to other factors) to maintain the equipment—particularly "hi tech" systems—at even a minimal level. As a result, developing countries suffer enormous losses and are burdened with unnecessary expenditures.

Those concerned with the utilization, maintenance and repair of equipment in the developed countries fully recognize the various factors conducive to the malfunction, poor performance and failure of instruments; these factors are categorized below.

1. Human and managerial factors

These are seen as the most significant factors, as they lead to an increase in the probability of equipment failure in general, and of electronic system failure in particular. The human factor is extremely important, as poor judgement could result in problems ranging from the selection of inappropriate to the procurement of low-quality instruments. More often than not, troubles in this area are ascribed to the lack of qualified personnel, the failure to keep up with current innovations, and an inadequate knowledge of international standards and technical quality-control specifications. The bureaucratic procurement procedures in many Arab States also contribute to this problem as does the poor and/or ineffective utilization of instruments especially the most advanced equipment, caused by either the under-qualification of end-users or a poor linguistic and/or conceptual understanding of operations manuals. A much graver issue relates to what one might call vocational ethics. Dealing with this problem requires a great deal of boldness, as it touches upon the sensitive question of user responsibility. (Many feel that their obligation is limited to the use of the equipment but not its safekeeping).

Finally, it is worth noting that Arab institutions and factories rarely have clear plans or programmes for periodic preventive maintenance, a factor which further contributes to the deterioration of the situation.

2. Peripheral factors

Some peripheral elements interfere with the safety and/or performance of instruments—e.g., the power supply, chemicals and corrosive materials/fumes at equipment sites, strong electromagnetic fields, ionized radiation, and in some cases, the presence of rodents and insects.

Power supply problems are the most serious; a poor quality or inconsistent power supply, i.e., transients, harmonics, sags, surges, EMI and frequent blackouts) is responsible for about 60 per cent of all equipment failure. The failure to earth (or the improper earthing of) equipment contributes greatly to the increase of failure or to the lowering of performance of delicate instruments.

Although suitable power-line conditioning devices may be available—e.g., voltage regulators, AC-filters, surge-suppressors and UPSs, the power supply may be so poor and irregular at times that no protective or conditioning measures can be truly effective, and some protection devices themselves become prone to malfunctioning.

3. Environmental (climatic) factors

Various climatic factors such as high ambient temperature, humidity or dust may, either directly or indirectly, cause instrument failure or degradation (aging), whether the equipment is in operation or in storage. Notwithstanding the fact that international standards and codes take climatic factors into consideration and are normally observed by most manufacturing companies, climatic factors are rarely given proper attention at the time of purchase. More often than not, this is coupled with the absence of effective control—i.e., checking the compatibility of the specifications submitted by manufacturing companies with international standards and with the prevailing environment. Certain pieces of equipment with definite climatic specifications are frequently utilized in areas with completely different environments. Fortunately, a good number of scientific, industrial and health-service institutions are

heading towards more tangible environmental control with respect to the operation of delicate instruments, and towards better observance of technical requirements and the use of air conditioners, dehumidifiers, dust filters and other available means. It is generally felt, however, that these measures are still limited.

C. "DEAD TIME" BETWEEN FAILURE AND REPAIR

No matter how efficient the measures are that are taken by institutions to improve the peripheral, environmental or human factors, or to conduct periodic preventive maintenance, instruments are prone to various types of failure during their lifetime due to the limited durability of some of their components. The problem in most Arab countries is that the "dead time", i.e., the time between failure and repair, is relatively long—often extending to weeks, if not months. This situation is alarming, given the potentially grave consequences resulting from equipment failure in the medical and scientific sectors, not to mention the financial losses suffered by the industrial sector. The main reason behind this lengthy "dead time" is the absence of practical know-how among the engineers and technicians in charge of repair. Engineering in formation provided at the universities and institutes in the Arab world is largely theoretical; and only very rarely do engineers and technical staff receive adequate or continued practical training following graduation.

To make matters worse, very few manufacturing companies have maintenance centres in the area; if they do, through their local agents, they rarely maintain acceptable technical standards. It has often been noted that the "friendly" relationship between a manufacturing company and its client normally ends with the termination of the contract and the expiry of the guarantee. The author's numerous and varied experiences in the Syrian Arab Republic have proven that the contribution of companies—in terms of providing suitable maintenance manuals or offering guidance and advice on repair matters—has been very limited. It has even been noticed—surprisingly—that certain companies resort to concealing part numbers and/or the description of some electronic components or to sealing them, with a view to making their local repair difficult, even in cases where the defect is relatively minor or simple to fix.

What may be yet a more serious problem in developing countries is the unavailability of sufficient quantities of appropriate spare parts when needed. This is further aggravated by the existence of local administrative bureaucracies, as well as the obvious reluctance of manufacturing companies to furnish their clients with the needed parts, especially when the requested item is no more than one electronic piece, which may be cheap but vital to the continued running of a sophisticated piece of equipment. The picture gets even worse as successive generations of the same equipment are developed more and more rapidly. The development of ever newer and more advanced models makes it even more difficult to obtain spare parts for the previous generations. Those involved in equipment repair know very well how hard it is to find adequate spare parts which would permit the extension of the "investment age" of certain equipment to make it economically viable.

D. THE PROJECT

The Syrian Atomic Energy Commission (AEC) has had a great deal of experience with all types and in all branches of scientific research. It has, on a daily and long-term basis, handled equipment designed for scientific, medical and industrial purposes—whether belonging to AEC or to other organizations, hospitals or factories. This experience has engendered the conviction that it is absolutely necessary for Arab institutions and scientific research centres and organizations to consolidate efforts in the field of equipment maintenance and repair. For this reason, AEC has requested ESCWA and UNIDO to establish a regional centre for maintenance and repair services. It has also informed ESCWA and UNIDO of the Syrian Arab Republic's readiness to host this centre

and provide it with the necessary support after completion of the feasibility study and consideration of the centre's requirements.

E. OBJECTIVES OF THE CENTRE

The far-reaching objectives for this project extend beyond the proposed appellation "regional instrumentation service centre"; there are aspirations to turn it into a prominent scientific and technical institution which meets the expectations of all concerned. The success of a project of this nature greatly depends on the will and active support of decision makers in the Arab States involved in the project.

Basically, the centre would be involved in the following:

(a) The local maintenance and repair of sophisticated mobile scientific, medical, nuclear and industrial equipment;

(b) The on-site maintenance and repair of equipment which could not be easily moved;

(c) The organization of periodic advanced training courses for Arab engineers and technicians—and possibly outstanding students—in the fields of analog and digital electronics, computer hardware, control systems and other related fields. Such courses could be conducted under the supervision of United Nations agencies and Arab scientific and educational institutions, and/or within the framework of bilateral agreements between States, between experienced bodies, or between major companies;

(d) The preparation of studies on preventive maintenance methodology and on efficient means for equipment protection. Consultative and advisory services to procurement agents could also be provided;

(e) The compilation and documentation of information for maintenance manuals, which would be distributed among participating countries;

(f) The undertaking of in-depth economic and technical studies on spare-part requirements, and on the possibility of organizing the central storage and distribution of spare parts;

(g) The design and execution of simple educational control circuits and systems and their distribution among Arab technical institutes and schools on an at-cost basis;

(h) Possibly using the centre's facilities to offer outstanding university and industrial school students practical training in the field of electronics repair.

F. ORGANIZATIONAL STRUCTURE

Similar to some existing cooperation projects in Asia and Latin America, and in order to facilitate communication and coordinate activities, the proposed regional centre could be linked through a network to a number of national centres in participating States; the national centres could also be linked to one another in a manner agreeable to all concerned. The national centre would be required to coordinate with the regional centre; where activities would be supervised by selected, highly qualified Arab engineers and experienced personnel. Short-term international experts/consultants could be invited to assist local personnel when the need arose.

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Annex V

UNIDO PROJECTS IN INDUSTRIAL AUTOMATION, MICROELECTRONICS AND MICROPROCESSOR APPLICATIONS

A. Production rationalization and automation

Industrial automation is the key to the efficient use of existing production capacities; it is also a key element in new investments. Gains to be achieved through industrial automation include reduced product costs and shortened delivery times.

B. Industrial automation and robotics

Problem: Engineering industries in developing countries are not competitive in import substitution and export markets, due to inefficient production capacity utilization, low product quality and limited product features.

Project: An institution-building project which aims at the establishment of a centre for industrial automation technology and robotics. The centre would provide services to small- and medium-scale engineering industries to improve product quality, cost effectiveness, and product features; and to shorten reaction time in the adoption of new products. Its services would include: (a) product and tool design; (b) robot applications; (c) consultancy on advanced production techniques; (d) manpower development; and (e) infrastructure-building for computer-integrated manufacturing (CIM) development.

C. The development of a computer numerical control (CNC) unit for machine tools

Problem: Rapid growth is expected in the utilization of CNC machine tools in developing countries. In countries with a sufficiently large domestic market and an already established machine tool industry, imports of CNC units would require large foreign currency allocations and dependence on foreign expertise for maintenance and repair.

Project: The creation of a centre with CNC-system-development capabilities (i.e., the appropriate human resources and physical facilities). The project would also include the transfer, assimilation and development of technologies for the design, development and prototyping of CNC systems.

D. Pilot flexible manufacturing system (FMS) for tractor production

Problem: Although agricultural mechanization has top priority in many developing countries, the proliferation of tractors is restricted by the relatively high costs involved and by the insufficient number of appropriate types for different crops and soils.

Project: The introduction of a pilot flexible manufacturing system (FMS) and an expert fault-diagnosis system at a tractor-manufacturing plant, so that the parameters leading to the successful implementation of FMS in different factories might be determined and analysed. The ultimate goal is to support the production of different types of tractors for different types of soil, and at the same time reduce production costs and make tractors available to a larger group of farmers, thus improving agricultural output.

E. Low-cost automation for small- and medium-scale industries (SMIs)

Problem: Small- and medium-scale industries (SMIs) suffer from high production costs and variable (or low) product quality. Although automation is an appropriate means of remedying many of these shortcomings, its costs are often beyond what SMIs can afford.

Project: Strengthening or creating an institute to develop low-cost automation packages: e.g., loading and unloading systems for lathes, presses and grinders; special-purpose machinery; and assembly-line machinery. The institute would also be expected to provide extension services and training to SMIs, and to assist them in modernizing their organizational and operational structures through automation.

F. A failure analysis laboratory for microelectronic components

Problem: Both electronic equipment producers and microelectronic component manufacturers from developing countries suffer from reliability problems, due to their low production yields and/or the later failure of components, sub-assemblies and assemblies.

Project: The establishment of a centre for the failure analysis of microelectronic components. The facility would be expected to provide testing services (which include the analysis of test results), especially to small- and medium-scale manufacturers who cannot afford similar services within their plants. The centre would act as a focal point for failure analysis studies and would cooperate with component manufacturers, equipment designers and producers, and research laboratories. UNIDO would provide expert services, technical staff training, and all of the necessary equipment.

G. Computer-based electronic integrated information system for plant operation and maintenance

Problem: Large process-based industries (those involved in iron and steel, cement, sugar, fertilizers, etc.) suffer from the lack of the information needed to maintain high-level plant performance, including the repair and maintenance of the production apparatus.

Project: The improvement of industrial productivity in the cement sector through the utilization of an electronic integrated information system. The system would optimize the transfer of know-how and information, at the man-machine interface; appropriate interventions would promote greater plant efficiency by increasing accessibility to the plant and the machinery.

H. Instrumentation services centre (ISC)

Problem: The development of a country's instrumentation techniques—collectively one of the main pillars of overall technical and technological development—depends on the efficient use of national instrumentation resources. A common problem is the lack of adequate repair and maintenance services, with the result that many instruments remain out of order.

Project: The creation of an instrumentation service centre (ISC) with a modular structure that would permit the establishment of some or all of the following modules at one time: (a) a national registry of instruments; (b) maintenance and repair services, including after-sales services; (c) instrument rental services; (d) consultancy services; (e) training in measurement techniques, service-designing, and specific measurement set-up; (f) making expert staff and instruments available; (g) the development of new, special-purpose instruments; and (h) other training.

I. ENVIRONMENTAL MONITORING AND CONTROL

Environmental monitoring and control is receiving greater attention in developing countries. The possible negative impact of environmental degradation on the economic, social and health-related aspects of life in developing countries is of paramount importance. However, activities related to stabilizing and/or improving the environment in developing countries are hampered by the lack of know-how and/or the lack of measuring, testing, analysis and control equipment.

J. WASTE MINIMIZATION IN THE ELECTRONICS INDUSTRY

Problem: Contrary to what was first believed, the electronics industry produces a large quantity and variety of pollutants in its products and manufacturing processes. New regulations and/or standards are required to minimize the negative impact of this industry on the environment.

Project: An economically and environmentally viable clean-up operation requiring careful preparation and execution. After carrying out a pollution audit of a selected company, the project would focus on the elimination of CFC solvents and on waste minimization and treatment.

K. NOISE ENGINEERING

Problem: Industrial noise pollution decreases productivity and can damage workers' health.

Project: The creation of a noise engineering centre, complete with special-purpose facilities (anechoic chambers, etc.) which would allow for the use of multi-purpose noise engineering techniques in industrial pollution monitoring and control, and in other industrial activities such as investigating and reducing the operating noise levels of domestic appliances (especially export items) and/or industrial equipment, and analysing the noise signatures of industrial equipment and systems for diagnosis and repair purposes.