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The Technological Knowledge Base for Industrializing Countries

Proceedings of the NBS/AID UNCSTD Seminar
Held at the National Bureau of Standards
Gaithersburg, Maryland
October 16-17, 1978

Edited by

Raymond C. Sangster

Office of International Relations
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FOREWORD

Every country in the process of industrialization finds that various types of technological knowledge are essential to the efficient establishment and operation of industrial plants. Among these are the knowledge required to: (1) measure process characteristics and product performance; (2) ensure that standards for health, safety, and performance are met; (3) control manufacturing processes to ensure that product quality is adequate; and (4) enable a wise selection of technology for industrial application to be made. The ability to obtain and use such knowledge is of importance to every individual who is concerned with the application of science and technology for economic development.

National services in standardization, measurement technology, and product quality control have come to be recognized as essential elements of the technological infrastructure needed for economic and industrial development. In the United States, the National Bureau of Standards is an important component of that infrastructure, working in a complex and ever-evolving relationship with the private sector and with other agencies of the Federal government. Early in the year 1971, our institution began an experiment in cooperation with the U.S. Agency for International Development to explore ways in which we might use our own capabilities to help strengthen the infrastructure of the less-developed nations of the world.

In the intervening period, several different techniques have been employed for this purpose. We have organized workshops such as the one associated with this Seminar; we have conducted surveys of the needs and capabilities of selected countries; we have provided written standards of ANSI, ASTM, and other organizations; and we have supplied Standard Reference Materials needed by laboratories in some of the participating countries.

The impetus for this Seminar was a desire to contribute to the U.S. preparations for the United Nations Conference on Science and Technology for Development (UNCSTD) which will take place in Vienna in August 1979. This Seminar has been organized to explore the needs for knowledge of the type described above, knowledge which is a central part of The Technological Knowledge Base for Industrializing Countries, and the procedures for acquiring and applying it. These Proceedings are part of the background material for preparation of U.S. positions in the Conference.

In this Seminar we are pleased to have the cosponsorship of the Office of Science and Technology of the U.S. Department of Commerce, of the Office of the U.S. Coordinator for the UN Conference on Science and Technology for Development in the U.S. Department of State, and of the Office of Science and Technology of the U.S. Agency for International Development. Representatives from all of the sponsoring organizations took an active part in the Seminar, and contributed substantially to its success. They were joined by a total of 97 registrants from many sectors of American society and U.S. Government Agencies, and from 25 nations, 22 of these being in the less-industrialized category.

The record of the discussions that follows will be helpful to the National Bureau of Standards as we pursue our joint program with the Agency for International Development. Also, I trust, it will be helpful both to those preparing the U.S. positions for the UN Conference and to the officials in this and other countries as we strive to apply the methodology of measurement, standardization, and quality control to the betterment of the global society in which we all live.

Ernest Ambler
Director

ABSTRACT

The National Bureau of Standards held a two-day seminar to explore needs for the technological knowledge base for industrializing countries and procedures for acquiring and applying it, in the areas of measurement capabilities and services required by technological industry, national and international standards that must be satisfied by industrializing nations, knowledge required for industrial quality control, knowledge required to enable a country to acquire commercial industrial technology, and managerial responsibilities and technical knowledge. The Proceedings are background material for preparation of U.S. positions at the UN Conference on Science and Technology for Development in Vienna, August 1979. Cosponsors included the Office of Science and Technology, Department of Commerce; U.S. Coordinator for the UN Conference, Department of State; and the Agency for International Development. The 97 registrants came from Argentina, Barbados, Brazil, Egypt, Guyana, India, Indonesia, Jordan, Kenya, Korea, Lesotho, Mexico, Pakistan, Panama, Philippines, Saudi Arabia, Singapore, South Africa, Sudan, Switzerland, Taiwan, Tanzania, Tunisia, Turkey, and many public and private organizations in the U.S. Key words used to summarize the conclusions were: local realities; industrialization; import, adapt, and innovate; complexity; technology assessment; indigenous capabilities; metrology, standardization, and quality control; survey projects; instrumentation; international standardization; existing plant; access to industrial technology; management; organizational climate; the human resource; the UN. All are important and need attention/support.

Key Words: Africa; Asia; developing countries; industrialization; Latin America; management; measurement; metrology; quality control; standards; technology transfer; UN Conference on Science and Technology for Development (UNCSTD).

PREFACE

Scheduling of the NBS/AID UNCSTD Seminar on The Technological Knowledge Base for Industrializing Countries on October 16-17, 1978, was congruent with the 1978 NBS/AID Workshop on Standardization and Measurement Services, to allow participants in that Workshop to also participate in this Seminar. The program (see Appendix I) was structured in eight technical sessions plus an evening dinner meeting. The technical sessions typically encompassed two principal papers plus a number of "short contributions". The principal speakers included five from the United States and seven from abroad, six of whom travelled to the U.S. expressly to participate in this Seminar. Most of the "short contributions" were provided by the participants in the NBS/AID Workshop. Appendix II contains the complete list of registrants.

This seminar was not an intergovernmental conference. All of the speakers, except for those officially connected with the U.S. preparations for the UN Conference on Science and Technology for Development, were speaking as individuals, or perhaps as representatives of their organizations; with possible rare exceptions. they were not speaking officially for their governments or their countries. As a result, the U.S. was privileged to receive as input for its planning for the UN Conference the personal opinions of a wide range of exceedingly knowledgeable individuals.

The printed record in these Proceedings was derived from a number of sources. Each principal speaker provided an advance copy of his prepared paper. The Workshop attendees submitted, for Workshop purposes, papers describing the situations in their countries in the broad field of standardization and metrology; some also provided manuscripts prepared specifically for their presentations at the Seminar. A taped record was made of the entire Seminar. The editor used his judgment in transcribing the tapes and in combining the material from the different sources into final manuscripts. Editorial judgment was also used in selecting from the material in the Workshop papers the content that would be useful in these Seminar Proceedings. Papers 4.4 and 7.1 were prepared for use at this Seminar and Workshop; they are being included here even though they were not presented during the Seminar due to the unfortunate inability of their authors to be present.

The organization of the Proceedings deviates from that of the Seminar Program. Section 4 in the Proceedings is the result of Session V in the Program, Section 5 presents the dinner speech and discussion by Ambassador Wilkowski, and Section 6 includes the results of both Sessions IV and VI. The original order of presentation of the "short contributions" has substantially been ignored; these manuscripts are presented herein in that proximity to the manuscripts of the principal speakers which will make these Proceedings most useful. Due attention was paid to maintaining the intelligibility of the discussion periods that dealt with more than one paper.

As will be seen by reading these Proceedings, the opinions expressed by the authors usually exhibit a remarkable convergence. On the other hand, there are some differences of opinion, also. It is obvious that some recommendations may have been put forth or conclusions drawn in these papers that are at variance with the normal conclusions and recommendations that would be advanced by the National Bureau of Standards or the other sponsoring agencies. Therefore, the conclusions and recommendations of individual authors are not necessarily supported by the U.S. Government or any of the sponsoring agencies. On the other hand, we are all indebted to these authors for presenting the realities that they see, for that provides us an opportunity to reexamine our own positions and perhaps to modify them to be more responsive to the situations in the industrializing countries.

In every case, a substantial effort has been made to give each contributor an opportunity to review the final manuscript of his contribution and to make those changes desired. Time and distance precluded complete effectiveness in this endeavor. Thus, the successes of these manuscripts are those of the authors, the failures those of the editor.

As editor and coordinator of this Seminar, I wish to acknowledge the inspiration and guidance received from Dr. Edward L. Brady, NBS Associate Director for International Affairs, and Mr. H. Steffen Peiser, Chief of the NBS Office of International Relations. Dr. Brady and Mr. Peiser were responsible for the conception and design of this seminar, and provided essential guidance in the selection of the principal speakers.

Raymond C. Sangster
Seminar Coordinator and Editor

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NBS/AID UNCSTD SEMINAR

THE TECHNOLOGICAL KNOWLEDGE BASE FOR INDUSTRIALIZING COUNTRIES

October 16-17, 1978

National Bureau of Standards
Washington DC 20234 USA

SUMMARY

This summary section consists of two parts, Part I - Conclusions and Recommendations, and Part II - Highlight Excerpts.

The purpose of the Seminar was to provide background material for preparation of the U.S. positions at the United Nations Conference on Science and Technology for Development (UNCSTD) which will take place in Vienna in August 1979. In her address to the Seminar, Ambassador Wilkowski, U.S. Coordinator for preparations for the UN Conference, specifically requested "helpful guidance and recommendations on how we can better prepare for this Conference in a way which will be directly relevant to the needs of the developing countries."

Many of the participants in this Seminar did indeed make specific recommendations relevant to the U.S. preparations for the Conference. Further, the convergences of opinion regarding the facts of the situation in the industrializing countries, their needs, and the desirable approaches toward meeting those needs, that can be seen from studying these Seminar Proceedings, also suggest conclusions and recommendations that may well be useful in the U.S. preparations. On the other hand, it should be noted that the Seminar was not structured in such a manner -- indeed, it was all too short for such purposes -- as to allow any substantial explicit consensus to be reached among the participants regarding conclusions and recommendations. Therefore, Part I of this Summary represents only the implicit consensus of the Seminar participants, deduced by examination of the papers and discussions in the printed record which follows. Responsibility for the accuracy and completeness of the statement of this implicit consensus rests with the editor of these Proceedings.

The conclusions and recommendations of Part I are not necessarily either new or specifically within the intended focus of the Seminar. Many have long been well established as a fundamental part of the U.S. approach to the UN Conference. They are included here for three reasons: (1) Reiteration can strengthen the U.S. commitment to these positions, especially when it is the result of a broad and overwhelming consensus, which often is the case for this Seminar. (2) Presenting the total range of conclusions and recommendations serves to put those specifically dealing with measurements, standardization, quality control, technology transfer, and technical management into the total context of the discussions and of the interests and concerns of the group of people convened together for this Seminar. As a result, those conclusions and recommendations falling narrowly within the scope of this Seminar become more comprehensible. (3) To a significant extent, this set of conclusions and recommendations deals comprehensively with the total subject of science and technology for industrial development, and is therefore useful to have explicitly on the record.

The intent in Part II - Highlight Excerpts was originally to develop an executive summary of the Seminar by piecing together excerpts from the papers and discussions. The format has been retained, but at its present length, this section is too long to be dignified with the title "executive summary." It was created as suggested above, by excerpting key statements from each of the papers and from some of the discussion segments. The excerpts were chosen to highlight the contributions to the overall conclusions of the Seminar that were made by the different papers or discussions. A minimum of rewording or paraphrasing was done. These excerpts are not reliable abstracts of the total scope of the individual papers. A draft of this section was circulated to principal participants in November. The responses were uniformly favorable, and the revisions requested were few.

Part II was used as the direct source of the conclusions listed in Part I. Some of the recommendations in Part I also came explicitly from Part II. Most, however, were phrased by the editor. Many more conclusions could have been listed. The ones actually listed are those that are reasonably comprehensive in scope and for which significant action recommendations can be stated.

SUMMARY - PART I - CONCLUSIONS AND RECOMMENDATIONS

CONCLUSION 1. LOCAL REALITIES.

The local situation must be fully taken into account in considering science and technology for development. Any approach which is oblivious to local realities is unacceptable.

The responsibility for observing what the industrialized countries are doing, picking what they think they need, and adapting it to fit the organization and economy of an individual country, is clearly the responsibility of the developing country itself. The industrialized nations cannot set their values on these decisions.

Technology is not an end in itself, and it is not the only means toward the specific goals of a country. We must be willing to consider the needs for a country to want to emphasize cultural diversity and other such things.

We are not really transferring technology. We are building a system in which our choices are in part to take from outside and in part to build from inside, to contribute to growth. It is only going to work if it is tied in with and contributes to the growth of local resources, if it supports local objectives, and if it enables us to build up the technical and innovative and managerial skills of local personnel.

Foreign managed ventures should understand, respect, and support the traditional habits and traditional social standards of the local people.

RECOMMENDATION:

The focus on local realities, responsibilities, capabilities, and goals should be a keystone in the U.S. approach to UNCSTD.

CONCLUSION 2. INDUSTRIALIZATION.

The growing industrialization of the world is probably one of our strongest forces for lasting peace, involving as it does the gradual elimination of need and meeting the requirements of individual societies.

The Industrial Revolution is now entering a most promising and complex phase, as it becomes global in scope. Most of the industrializing countries are newly independent and are intent on shaping strategies of industrialization suitable to their own goals, needs, and values. These national orientations are to be matched with a world situation in which international mobility of technology and resources is creating new forms of interdependences among nations.

Technology, in the sense of the practical application of invention and discovery, is as old as mankind itself. What is new is the science-based technology, the outcome of industrial research, a phenomenon of the present century.

For the first time in history, we have at our means the resources and the ability to bring about a better life for all peoples.

If we uplift the world, everyone stands to benefit.

RECOMMENDATION:

The U.S. position at UNCSTD should include a major emphasis on science and technology for industrialization, and industrialization should not be relegated to a secondary status at the Conference.

CONCLUSION 3. IMPORT, ADAPT, AND INNOVATE.

To obtain scientific and technological development in an industrializing country, it is necessary to import advanced science and technology vigorously, to build up domestic capabilities to fully absorb, digest, and adapt imported technology to domestic conditions, and to develop self-sustaining capabilities for local innovation in science and technology.

RECOMMENDATION:

The U.S. should consistently operate from the basis of this three-pronged approach. Each element is essential.

CONCLUSION 4. COMPLEXITY.

The "standard problem" for developing countries is the complex composed of problems of education, or promotion of awareness or consciousness, of facilities, and of the system for development.

RECOMMENDATION:

The U.S. should consistently push for recognition of the critical nature of all aspects of this "standard problem" and for balanced approaches that will attack all aspects in accord with the needs in any given situation.

CONCLUSION 5. TECHNOLOGY ASSESSMENT.

When the developing nations have decided what they wish to become and the kinds of choices they want to make, they can use some assistance, to be defined by them, in developing human resources and institutions so that they are better able to make these choices in a much more self-reliant way than they can now do.

If we stop thinking of industrialization as a developmental state rather than as a developmental process, we will see that the main way we can help is by teaching that process.

Specific industrial objectives should be based realistically on internal capabilities, world markets and resources, and the time required to develop a technical base compatible with these objectives. Indigenous capabilities are required to adapt and then to emphasize those areas of technology most relevant to national objectives.

Developing countries need national centers for technology transfer, and appropriate training; mechanisms for assessing the applicability of a particular technology within a country and for comparing it with all the other technologies available.

RECOMMENDATION:

The U.S. and the UN should move to develop mechanisms that will enhance and support the ability of the industrializing countries to assess, select, adopt, adapt, and innovate in the technological areas that they determine to be of value to them. In particular, the U.S. and the UN should move to organize themselves to be able to provide pertinent educational and training services more effectively and more efficiently than they now do.

CONCLUSION 6. INDIGENOUS CAPABILITIES.

While the West needs scientific research upon which to build its high technology, most of the technology the developing world needs already exists, and the immediate need is to learn to select, adapt, and use it. More emphasis is needed on engineers, relative to scientists.

The overwhelming need and demand of the industrializing world is for help in developing their own indigeneous capabilities in science and technology and in the whole range of activities from creation of technology to development and marketing of products to managerial expertise generally.

One of the major tasks facing the developing countries is to create, nurture, and more often than not, rehabilitate, their internal capacity to invent and innovate.

The main obstacle to the complete nationalization of imported technology is connected with the lack of capability in the product design and engineering function. This capability can only be developed through an R, D and E approach, that is, through an interaction of engineering groups with the R and D capability.

You have to organize and maintain the local institutions whose support may be of the utmost importance in the practical use of technology.

Developing countries need encouragement of local R, D and E, and reversal of the brain drain to put local talent to work on local problems.

Foreign and multinational enterprises in the industrializing countries often appear uninterested in supporting development of the technological institutions in the host countries, or in participating in their programs.

A long-term plan of cooperation could make flourishing local research institutions profit from the experience, capability, and ingenuity of American universities and research institutions, in the development of a sound R, D and E basis for the industrializing country.

RECOMMENDATION:

The U.S. position at UNCSTD should support all effective moves to enable the industrializing countries to enhance their indigenous capabilities to assess, select, adopt, adapt,

and innovate in the technological areas most relevant to their national objectives. The U.S. should seek ways in which it can encourage its industrial and educational enterprises to support and participate in the work of indigenous technological organizations in developing countries. The U.S. should support in UNCSTD realistic moves by the developing countries to encourage or require such support and participation by foreign enterprises operating in their territories.

CONCLUSION 7. METROLOGY, STANDARDIZATION, AND QUALITY CONTROL.

The knowledge base associated with metrology, standardization, and quality control must be present as part of the technological infrastructure needed to support industrial development. Indigenous capabilities in these fields are indispensable.

Participation in the world export markets and in the world technological community, as through a national airline, demands a domestic measurement system that allows domestic organizations to demonstrably meet international technical requirements.

The economic development of a country must have available machinery for ensuring high standards of quality and accuracy for both its indigenous products and imported equipment and commodities.

Standardization is becoming a prerequisite for improving domestic quality, and, hence, for becoming competitive in the world markets.

Expansion of export volume promotes industrial development.

National standards are especially needed for consumer products which can affect health and safety or for which there is monopoly ownership. Standards for exports should be set by mutual agreement between the parties concerned.

Technical standardization represents a sum and a summary of the best achievements of science and technology. Standards institutes open the doors to improved knowledge of progress and experience throughout the world.

It may be difficult to apply foreign or international standards without modifying them in the light of existing facilities and actual needs. Specific national or regional standards may be needed.

The formal introduction of standards and standardization in a society will be faced with some difficulties, in particular those generated by resistance to change.

Quality control and its related disciplines have played a significant role in bringing about an improved standard of living for the industrialized countries and those rapidly reaching that status. These same concepts and disciplines will likewise be of great importance to the developing nations.

RECOMMENDATION:

The U.S. position at UNCSTD should encourage international recognition of the essential roles of standardization, metrology, and quality control, and the development of UNCSTD actions and recommendations that will support (a) efforts within the industrializing nations to achieve local recognition and support for standardization, metrology, and quality control systems within their countries; (b) the efforts of existing international and regional organizations in these fields; and (c) enhanced international and bilateral aid for the development of adequate capabilities in these fields in the industrializing countries, in all dimensions, e.g., financial, technical advice, and international and regional coordination.

CONCLUSION 8. SURVEY PROJECTS.

Standardization and measurement survey projects conducted with the support of existing institutions in the industrialized countries are very valuable in the creation of an infrastructure for industry in the developing countries.

RECOMMENDATION:

The U.S. should continue its successful pattern of such survey projects, and it should press for UN recognition of the role of existing national institutions in such survey projects and for an enhanced program of the UN to employ the capabilities of such institutions.

CONCLUSION 9. INSTRUMENTATION.

The available instrumentation from the industrialized countries tends to be too elaborate and too expensive, and not adapted for the climatic conditions of the developing countries.

RECOMMENDATION:

The U.S. should support efforts to develop instrumentation institutes and industries that are responsive to the specific needs of the developing countries.

CONCLUSION 10. INTERNATIONAL STANDARDIZATION.

International standards support elimination of obstacles to the better utilization of knowledge and capabilities in science and technology for the development of all countries, particularly for their use in developing countries. They operate as a neutral vehicle for the transfer of technology, and are available at minimum cost.

It is possible to take over directly and integrally a large number of international standards as domestic standards, no matter what the level of development of the country.

Any country hoping for even modest success in the international standards negotiations must have continuity of representation by qualified technical experts who are well-briefed, nimble thinkers, willing to work hard. Participants from the less industrialized countries can be very valuable neutral third parties, helping the adversaries reach optimum compromises.

The membership fee in the international standardization organizations is outside the financial ability of some very small developing nations; proportioning membership fees to GNP would help.

The industrialized countries can help the developing nations by applying certification and quality-mark systems to all exported products.

The possibility of reinforcing the prevailing methodology by integrating the administrative and research approaches with the consensus method of preparing standards needs to be explored for use in developing nations just embarking on standardization activities.

RECOMMENDATION:

The U.S. should press for extensive recognition of the importance of the international standardization system in the UNCSTD context. The U.S. should support efforts to enhance the capabilities of international standardization organizations to respond to the needs of specific developing countries and regions. It should support efforts to increase the consciousness of these organizations of the needs of developing countries and to increase their ability to respond to them broadly. The U.S. should support international approaches to finding more effective means for enabling newly industrializing countries to meet their needs for standards.

CONCLUSION 11. EXISTING PLANT.

Improving maintenance and repair in developing countries would be one of the most important and effective ways of stimulating industrial development at low cost. Standardization of equipment is one means of simplifying maintenance work. The possibility of achieving international standardization of equipment intended for developing countries is remote, and the solution of this problem lies within each developing country.

Developing countries need better management and improved technological developments in existing industrial plants.

RECOMMENDATION:

The U.S. should promote consciousness of the seriousness of these problems and efforts to support their resolution, by
(a) action at the international level oriented toward the sources of equipment;
(b) action to support individual developing countries to control their maintenance and repair problems; and
(c) programs specifically aimed at enhancing the efficiency, effectiveness, and productivity of existing plants and other capital investments in the industrializing nations.

CONCLUSION 12. ACCESS TO INDUSTRIAL TECHNOLOGY.

The industrializing countries should make deliberate efforts to develop close ties with industrial sectors in the developed countries, in order to create a reservoir for potential cooperation for training, for exchange of personnel, and for establishment of indigenous technical institutes. Private companies can be a powerful aid to industrializing countries in building a technological base.

The tremendous reservoir in the United States of know-how in commercial industrial technology is not really being made as available as it might be to the developing world. Mechanisms for utilizing the private sector must be looked at.

When problems arise in any particular technological area, there ought to be a way to access people in both the industrialized

countries and other industrializing nations, to determine if existing solutions are available.

It takes a lot of money and effort to develop a new process, product, or method; and an organization is not to be expected to hand this over to others without a profit.

Foreign investment promotes industrial development.

In negotiations for technology transfer agreements, adoption by both parties of a long-term mentality will help provide a climate of stability and mutual benefit. The transnational enterprise must view the transaction as a partnership, whereby it becomes a citizen of the host country, undertaking a commitment to its social and economic development, in return for a satisfactory profit. The host government should exert dedicated efforts to maintain a climate of stability so that the transnational enterprise does not believe that it will place in jeopardy its human and material resources.

Strong leadership and political stability are conducive to industrial development.

External technological dependency may lead to projects contracted abroad that involve importation of components and equipment that could have been made locally, to licensing and technical agreements which may lead to capture of local companies by foreign concerns, to unhealthy perpetuation of technical agreements, and to a lack of technologies for exploitation of non-conventional local natural resources.

Appropriate technology should promote national and local self-reliance. Some criteria for appropriateness include: high employment potential; low required investment; utilization of domestic material resources; strong linkage to local industry to satisfy actual needs; higher productivity than traditional technology in the same field; easy maintenance; compatibility with prevailing sociological conditions in the locality. Technology is needed for production for and by the people, to promote both economic growth and social justice.

Developing countries need promotion of small-and medium-sized businesses.

RECOMMENDATION:

The U.S. should seek to go the UNCSTD prepared
(a) to make specific offers of moves on the part of the U.S. government that would encourage the private sector in the U.S. to be more accessible technologically to the industrializing countries,
(b) to make specific recommendations to the industrializing countries on moves that they can or must take to attract cooperation from private U.S. firms, and
(c) to propose that the UN should move to establish enhanced networks, both institutional and informal, that will promote in the fields of technology the type of person-to-person and institution-to-institution interactions that now exist in the fields of science, internationally.

CONCLUSION 13. MANAGEMENT.

A critical factor is the ability to manage technical resources. The technical manager is the single most needed person.

Developing countries have an imperative need for sound planning and project design, nationally and on a sectorial level.

Poor management is probably the single greatest problem in industrial development.

RECOMMENDATION:

The U.S. should support all effective moves to enhance the competence of the technical managers in the industrializing countries.

CONCLUSION 14. ORGANIZATIONAL CLIMATE.

The organizational climate in an industrial concern has to be one in which managers accept the paramount importance of people, coequal with technology and financial resources, as a prime ingredient in organizational accomplishment, and one that focuses the attention of managers on performance.

RECOMMENDATION:

Programs for managerial development in the industrializing nations should include a stress on organizational development, to promote organizations that demand performance and that are sensitive to the paramount importance of people.

CONCLUSION 15. THE HUMAN RESOURCE.

The most important resource is the human resource, the working personnel. A critical aspect of this resource is quality consciousness and the ability to detect promptly and act to remedy any situation that involves a dev ation from the pre-set minimum standards of quality.

Technology only resides in human beings, and we can only transfer this technology from one human being to another. If there are too many cultural differences, so that we cannot even understand each other, then technology cannot be transferred.

Industrial development is promoted by an abundant, skilled labor force with a high level of education.

The first and foremost problem is manpower availability. Foreign ventures and consult ing organizations should be required to train local manpower and to lay the basis for a genuine local takeover of the enterprises.

It is necessary to develop people who can not only adapt, but also innovate.

The educational level in developing countries needs to be balanced among theory and practice, science and technology, basic research and application in engineering.

It is necessary for a developing country to develop a body of highly motivated technologists, scientists, and technicians, possessing a belief in their own destiny.

The young generation in a developing country should be taught to appreciate work, with their hands or otherwise, without shame or embarrassment. The desire to work and the sense of responsibility for development of their country must be introduced.

The will and dedication of the people and their hard work are the most important ingredient for economic development.

RECOMMENDATION:

The U.S. should press for general recognition of the attitudes, capabilities, and skills that must exist in the people of an industrializing nation if it is to succeed in industrialization, and it should support moves in education and consciousness-raising that will promote these attitudes, capabilities, and skills.

CONCLUSION 16. THE UN.

There needs to be introduced a new international agency to assist the developing nations in technology transfer, quality control, standardization, metrology, certification, and marketing. The proposed agency should form a triangle with the International Monetary Fund and the World Bank, to contribute technical and managerial assistance in the realization of industrial development projects.

RECOMMENDATION:

The U.S. should support at UNCSTD a thorough re-examination of the adequacy of existing institutional arrangements in the light of these and similar new needs.

SUMMARY - PART II - HIGHLIGHT EXCERPTS

1.1 Topics covered by this Seminar include metrology, standardization, quality control, technology transfer, and technical management. These are elements of the technological infrastructure needed to support industrial development. This knowledge base is an indispensable part of the development process. Without it, the best laid and clearest plans for industrialization would be very badly impeded. (Dr. E. Ambler, Director, National Bureau of Standards.)

1.2 The growing industrialization of the world is probably one of the strongest forces for lasting peace, involving as it does the gradual elimination of need and meeting of the requirements of individual societies. A useful working definition of "technology" is "that combination of the arts and sciences whereby industry creates the useful goods and services for a society." The word "useful" requires that there be a match of technology to the needs of society. We should recognize that when we talk about industrializing countries, we include the United States of America, for it, too, is still a developing country. (Dr. J. J. Baruch, Assistant Secretary of Commerce for Science and Technology, U.S. Department of Commerce.)

1.3 Industrialization of the Western world took place within roughly the same time period as development of the technology that was part of that industrialization. The simultaneous progression of industry and technology was evolutionary; they proceeded in a crude balance. Industrialization of the less developed countries today is taking place within a world that contains a complete spectrum of technology, from windmills to satellites. This situation differs from Western experience in two important respects:

(1) There is a strong element of national planning.

(2) Any technology selected for emphasis will almost certainly have been developed and put to use somewhere else, so that a "technology gap" exists by definition.

Objectives for industrializing countries include:

(1) Strengthening of existing national structures in natural resources, manufacturing, and services.

(2) Development of industries to provide the needs of domestic markets.

(3) Development of industries intended to create exports.

Specific industrial objectives should be based realistically on internal capabilities, world markets and resources, and the time required to develop a technical base compatible with these objectives. Indigenous technical capabilities are required to adapt and then to emphasize those areas of technology most relevant to national objectives. The measure of success is the effectiveness of integration of technology into a workable economic system. A critical factor is the ability to manage technical resources. The most essential person is the technical manager, who can understand and integrate the contributions of others.

The use of cooperative arrangements with multinational private companies should be in addition to, not instead of, the development of domestic technical skills. Complete "business packages" should be sought. There should be deliberate efforts to create close ties with industrial sectors of the developed countries, in order to create a reservoir of potential cooperation for training, for exchanges of personnel, and for establishment of indigenous technical institutes. Private companies can be a powerful aid to industrializing countries in building a technological base. (Dr. H. I. Fusfeld, New York University.)

1.4 Less developed communities within an industrialized country can serve as a paradigm for less developed countries within an industrialized world, but the paradigm is not an exact one.... When there is a problem in a developing country, there ought to be a way of accessing people in the United States or in any one of the other countries represented here. This group has gotten together because of a common interest in industrialization of a wide range of countries, and forms the basis of a network for such interactions. ... The responsibility for observing what we are doing, picking what you think you need, and adapting it to fit the organization and economy of your individual country, is clearly the responsibility of the developing country itself. We cannot set our values on it. In the past much of our infrastructure approach of providing institutes and training of manpower seems to have ignored the fact that these are 30 year projects compared with the demands for essentially 2-5 year projects. ... In any organization you find two different sets of activities, "goal selection" and "goal pursuit". Something becoming increasingly obvious is the bringing together of the politico-technical process to continually iterate this process of selection--pursuit--selection--pursuit.... While there is a tremendous reservoir of technology in the private

sector of the West, the only realistic hope of getting the cooperation of private companies is when there is a business interest in the company in the country that is asking for it.... Our latest is not necessarily their best.... If we stop thinking of industrialization as a developmental state rather than as a developmental process, we will see that the main way we can help is by teaching that process.... (Discussion following papers of Drs. Baruch and Fusfeld.)

2.0 Not only do you need to know where you are, but also where you are going, and how to communicate with others. These are the key points in the use of measurement capabilities and services, because if you don't have these, you neither know where you are nor do you have a sound base from which you can decide how far you have come and where you are going. (H. Herman, Industrial Consultant, Potomac, Maryland.)

2.1 If scientific and technological development are to be obtained, firstly, advanced science and technology should be vigorously imported, secondly, domestic science and technological capabilities have to be built up to fully absorb, digest, and adapt imported technology to indigenous conditions, and to create self-sustaining capabilities for local science and technology. The main factors in the remarkable industrial development of Korea are:

(1) Strong leadership and political stability.

(2) Will and dedication of the people; hard work.

(3) Abundance of skillful labor force with a high level of education.

(4) Successful introduction of foreign investments for industrial development.

(5) Success of export volume expansion, a 300-fold increase since the beginning of the economic development plan in 1962.

Since 1972 Korea has been building up its heavy and chemical industries, and a corresponding new measurement capability has had to be created. Standardization and measurement survey projects, such as that conducted by NBS/AID in Korea in 1972, play an immeasurable role in the creation of an infrastructure for industry in the developing countries. At this time, no systematic nationwide calibration/inspection network exists in Korea. A fact-finding survey has been conducted to establish a basic policy for the needed system. It revealed that:

(1) Industry has an insufficient number of precise and accurate measuring instruments necessary in the manufacture of products meeting established standards.

(2) The calibration of measuring instruments is not regularly done, in spite of the fact that it is necessary to maintain precision and accuracy.

(3) Management, especially top management, is lacking in understanding of the importance of metrology to industrial progress.

(4) There is an insufficient distribution of standard reference materials.

(5) Industry lacks an understanding of the need for standard reference materials.

To promote an awareness of the importance of the metrology and standards system and its full utilization by industry, the Industrial Advancement Administration launched in 1975 a massive nation-wide quality control campaign, which has proved successful in establishing awareness of the importance of quality control and has induced utilization of the evolving national measurement and standards system. (Dr. Jong Wan Choi, Industrial Advancement Administration, Korea.)

2.2 With the utilization of Korean national standards traceable to internationally recognized standards, the newly established metrology system in Korea is expected to make a great contribution to a high percentage of accurate measurements, decreased reliance by Korean laboratories and firms on foreign facilities for the supply of standards and calibration services, and an increasing number of measurement standards developed or modified to satisfy Korean needs. (Dong Ho Kim, National Industrial Research Institute, Korea.)

2.3 The Mexican General Electric Company was established in 1896 as a sales outlet for GE products imported from the United States. Today, it manufactures a wide range of lamps, consumer products, and industrial goods. It has approximately 5000 employees and annual sales of $104 million.

Most of the components of products are made in Mexico, but certain critical items are imported from the United States. The manufacturing equipment, basic designs, engineering, and systems, come from the highly specialized parent company departments in the United States. Very critical measurements have to be made of some of the components, since they affect both the quality of the products and the yield in manufacture. A network of exchange of samples and reference materials and methods between the General Electric laboratories in Mexico and the U.S. is used to ensure the adequacy of these critical measurements. The quality level achieved allows products to be exported to Germany,

France, and, above all, the United States. Following a set of routine procedures is not enough to allow achievement of this level of quality. The following of routines sometimes tends to degenerate through the years, because it is sometimes much easier to manufacture with components slightly different in dimensions or by slackening some of the specifications, but always within the current standards of acceptance.

The most important factor to accomplish a truly competitive quality is to instill in the working personnel quality consciousness and awareness of the need for accurate measurement of properties and the need to detect promptly any deviation that could occur from the pre-set minimum standards of quality for any of the parameters. An essential ingredient in the training and development of personnel is the climate of the organization, the cluster of concepts, attitudes, and patterns of behavior that make up the organizational environment within which people develop their potential as managers or high caliber technicians. This climate has to be, first, one in which managers accept the paramount importance of people, co-equal with technology and financial resources, as a prime ingredient in organizational accomplishment. Secondly, it has to focus the attention of managers on performance, if they are going to maximize the contributions of their subordinates and their development. One of the first steps taken to establish this kind of climate to develop an effective training plan was to adopt the Quality Control Circle concept developed in the 50's in Japan. One of the most refreshing experiences in this kind of program is the eagerness to learn that is present in practically all of the Mexican workers.

The three principal factors key to the success of a technological industry in Mexico are

(1) the technological support from a very qualified company in one of the older industrial nations,

(2) the absolute conviction that the most important resource in any given enterprise is the Human Resource, and

(3) an adequate approach to the training and development of that Human Resource, with the proper motivation.

(R. Coria, General Electric de Mexico, Mexico City.)

2.4 After the Second World War, the development of heavy industry in Argentina created a need for interchangeability of parts, that contributed to the establishment in 1957 of the Instituto Nacional de Tecnologia Industrial (INTI) to provide the needed metrological reference base. To get experience, INTI sought help from organizations like PTB (West Germany), NBS (USA), NPL (Great Britain), and LICE (France). Metrological advances at INTI are transferred to industry through calibration and other services. For instance, INTI calibrates electronic instruments used in the maintenance of air navigation equipments, because the U.S. FAA demands that all air navigation enterprises that fly over the USA must have their instruments under metrological control. Similarly, the Argentine automobile factories are finding that in many countries to which they export there are regulations limiting the amount of radiointerference due to ignition systems; resolution of this problem demands careful and difficult measurements. (H. F. Mazza, INTI, Argentina.)

2.5 Reliable measurements are not the result of laws. They come out of hard and conscious labor. However, a favorable set of laws is helpful, as it brings our a receptivity for awareness of these problems. Further, reliable measurements do not come out by themselves; a reliable measurement must be used, and is the outcome of some kind of social pressure. (Admiral J. C. de Castro Waeny, IPT, Sao Paulo, Brazil.)

2.6 A central guiding system is currently being created for the standardization and measurement services system of Indonesia. An agreement has been signed between the private standardization organization YDNI and the National Institute of Science to expedite the establishment of a national system of standardization, and the preparatory committee for establishment of this system has been set up. The national Calibration Committee has been established. A network of calibration services will be created in the near future, built around nine specialized calibration centers. These developments have been based on a national survey on standardization and measurements jointly conducted by the National Institute of Science and the U.S. NBS in 1977.

The "standard problem" for developing countries is the complex composed of problems of education, of promotion of awareness or consciousness, of facilities, and of the system for development. In Indonesia a new minister has been installed in the present cabinet, the State Minister for Science and Technology. Very recently, the Agency for Assessment and Application of Technology was established, headed by the Minister himself. These developments demonstrate the importance attached by Indonesia to science and technology for national development. (Gandhi, M.E.E., YDNI, Indonesia.)

2.7 In India electronics is now playing a very vital role in a number of areas, and the electronics industry is on the point of take-off. To meet the growing demand for precision electronic measurements for the purpose of calibration of instruments as well as quality control, reliability evaluation, and interchangeability of parts, a national system for electronic measurement standards, calibration, and testing has evolved over the years. (Dr. K. Chandra, NPL, India.)

3.1 Advantages of standardization:

(1) Planning the attainment of a given objective need not be repeated each time.

(2) The concepts in the minds of the parties concerned are given definite meanings.

(3) More economic use of human effort, material, and time; hence lower cost of supply and distribution of goods and services.

(4) Variety of means necessary to cover a given range of needs is minimized.

(5) Interchangeability of component parts, assemblies, and complete products, making possible long-run, highly repetitive manufacturing, facilitating repair and replacement.

(6) Easier training of personnel, by means of instruction sheets, manuals, etc.

(7) Elimination of confusion and conflict, resulting in more harmonious and effective working together.

(8) Creation of a rational basis of understanding in contracts.

(9) Promotion of fair dealing in trade.

The economic development of a country must have available machinery for ensuring high standards of quality and accuracy for both its indigenous products and imported equipment and commodities. It may be difficult to apply foreign or international standards without modifying or adapting them in the light of existing facilities or actual needs; specific national standards may be needed. Regional standardization is an intermediate stage, harmonizing the standards of countries and fitting them to the circumstances peculiar to the area.

Developing countries lack the experience they need to make use of technological discoveries. In sectors where competition is based on taking advantage of the most recent advances in technology, there is only a small margin in favor of industrial growth in countries of low economic development. On the other hand, the wide sectors concerned with the production of basic goods needed by society as a whole, particularly foodstuffs, energy, metals, and nonmetallic raw materials, offer so many other possibilities for economic development, that, if proper use is made of them, they will provide the means for our societies to evolve at the rate which is necessary in order to diminish the present differences in levels of development.

Technical standardization represents a sum and a summary of the best achievements of science and technology, which, if associated with the practical experience of the advanced countries, will bring about rationalization of production, leading to better economy of the production factors and reducing losses, waste, repetition, safety hazards, and the whole succeeding series of negative effects for industry. Standards institutes open the door to improved knowledge of progress and experience throughout the world. They act as an arbitor between the conflicting interests of producers, consumers, and the general public. This is of paramount importance in finding a proper balance after decades of mutual ignorance have built up all kinds of barriers and obstacles, making it very difficult to achieve the mutual collaboration which is indispensable for countries who wish to move forward in a single constant direction.

Generally speaking, developing countries acquire technology at the company level, that is, through transfer from one company to another. It is very important for the licensor to take an active part in planning an industrial project in a developing country, and in carrying those plans out. The government's role in this sphere will be to define the specific objectives and to determine the type of technology and equipment to be imported and on what conditions, including how much adaptation will be required in order to bring industrial development plans to success.

Advantages of in-plant standards include:

(1) More attention devoted to fundamentals of design, dealing with just a few good designs.

(2) Product design may be simplified. The relations between product and process requirements may be studied more closely. Long runs of standardized items can be achieved, rather than many short runs of "specials".

(3) Inventories may be simplfied, and inventory costs cut.

(4) Work planning, production control, and other management procedures can be simplified, and their frequency of repetition reduced.

(5) Improved service may be offered to customers.

One of the prerequisites for efficient use of equipment is systematic maintenance and repair. Improving maintenance and repair in developing countries would be one of the most important and effective ways of stimulating industrial development at low cost. Standardiztion of equipment is one means of simplifying maintenance work. The possibility of achieving international standardization of equipment intended for developing countries is remote, and the solution of this problem lies within each developing country. (A. Fadlalla, Arab Organization for Standardization and Metrology, Cairo, Egypt.)

3.2 Product standards are documents which define sizes, shapes, dimensions, tolerances, and all of the other features which affect interchangeability of manufactured parts. They are by far the most difficult standards to develop internationally, because one or more countries must accept physical change in the products currently being produced and used domestically. Change is expensive and disruptive.

Standardization is a business function. It must achieve an adequate pay-off, or don't do it! Any country hoping for even modest success in international standards negotiations must have continuity of representation by qualified technical experts who are well-briefed, nimble thinkers, willing to work hard. During the initial exchanges, each spokesman presents articulate and compelling arguments why the national practice he expounds is technically superior and why the international standard should be written in its image. There is then serious and objective analysis of the technical merits of competing proposals. Almost always, the best answer is a combination of the better features from many proposals. Participants from the less industrializaed countries, often having no strongly held national positions to put forth, can be neutral third parties helping the adversaries to reach optimum compromises. Ultimately, if an international standard is going to gain acceptance and be used, its contents must reflect the best technical practice of any of the participating countries. This puts a severe burden on the less industrialized countries, because it requires them to meet the best, immediately, without the maturing processes that the more advanced countries have enjoyed.

Even after an international standard has been adopted, it may not be adequate in itself to serve as the national standard in some countries. It is often necessary to add specifications of additional parameters that have been traditionally used in a given country. The important fact is that these additional requirements not affect the functional interchangeability of the manufactured parts. (R. B. Belford, Industrial Fasteners Institute, USA.)

3.3 Industrializing nations must produce both for domestic consumption and for export. Compulsory national standards should be established for specific consumer products which can affect health or safety or for which there is monopoly ownership. Voluntary standards should be set for competitive products. Standards for exports should be determined by mutual agreement between the parties concerned. The quantum of membership in ISO is outside the financial ability of some small developing nations; proportioning the membership fee to GNP would help. Another problem is the lack of hard currency to purchase hardware and software and to develop much needed skilled personnel.

The formal introduction of standards and standardization in a society will be faced with some difficulties, in particular those generated by resistance to change. It is therefore necessary from the inception to have the stage well set to cope with this, firstly, by clearly defining the functions, powers, and structure of the organization charged with the responsibility for effecting the system of standards and standardization, and secondly, by acquiring the necessary legal tools for facilitating specific functional activities. Recommendations with respect to standardization in Guyana include:

(1) That standardization be accepted as a precondition for both technological and economic planning.

(2) That standardization be considered for rationalization of imports of capital goods.

(3) That standardization be a prerequisite for simplification of spare parts stocking and inventory management.

(4) That one-man (woman) businesses should be discouraged, and cooperatives be urged.

(5) That innovative steps be taken in educational policy specifically to generate substantially larger numbers of students of science and technology.

(6) That retired scientists and technologists who are able and willing to function be given the opportunity to be re-employed.

(7) That a distinction be made between Rural National Standards and Urban National Standards, in view of the need to relate rural production to rural technology, and to maintain community development in step with a progressive cultural outlook.

(8) That the Commonwealth Science Council should explore the possibility of convening a Metrication cum Metrology Conference in the Caribbean area, in order that the Caribbean may benefit from proposals for collaborative undertakings and share in certain calibration facilities and high-capital-cost testing equipment. (Mrs. Lorna Lawrence, Guyana National Bureau of Standards.)

3.4 The Comision Panamena de Normas Industriales y Tecnicas is responsible for establishment of technical standards for the Republic of Panama, and has extended its objectives to include quality control and metrication. (Ing. Maricela Ferrer de Chan, Panama.)

3.5 Standardization is one of the basic components which any infrastructure must include in order to develop a sound economy. It is the foundation on which to build up the store of knowledge which a country needs in order to be able to assimilate imported technology and utilize its own potential; it is becoming a prerequisite for improving domestic quality, and, hence, for becoming competitive on the world market. Standards broadly reflect the state of the art. By making use of existing technical data, standards find common solutions to recurring problems and consequently avoid waste in both materials and manpower. They lead to compatibility of industrial practices in different countries. International standards support elimination of obstacles to the better utilization of knowledge and capabilities in science and technology for the development of all countries, particularly for their use in developing countries. They operate as a neutral vehicle for the transfer of technology. They are available to developing countries at minimal cost. The national standards body plays a decisive role in the systematic development of the national economy and should be included in the planning work at the earliest possible point in time.

Although the need for standardization has been felt for a long time, a real effort to introduce standardization and quality control in the national economy was made only about three years ago, when the government set up the Tanzania Bureau of Standards (TBS). A principal aim of TBS is stimulus to industrial development. The major problem is that the needs are vast and pressing for the young TBS to meet. The establishment of priorities and the task of planning ahead become real difficulties. The possibility of reinforcing the prevailing methodology by integrating the administrative and research approach with the consensus method of preparing standards needs to be explored; the balance can always be maintained at the point the situation demands, the criterion being the need to produce usable standards in time.

Existing measurement, testing, and quality control facilities in Tanzania are very elementary and quite inadequate to support even a modest industrial development. Expansion of testing facilities and manpower is needed, to meet the aspirations of the country for self-reliance and a reasonable view of quality in products and services provided. (T. Rajaraman, Tanzania Bureau of Standards.)

3.6 Although it is not easy to realize immediately the activities of a Standards Organization in the economy of most developing countries, there are prospects of the Organization being very important in the day-to-day management of the economy, in order to create more order in the goods/money-worthness and quality. Training of the staff of the Kenya Bureau of Standards has been very much emphasized during the three years since its establishment, in the national standards organizations in Japan, Britain, Sweden, Germany, India, the USA, and Australia. Locally, the Bureau every year organizes a Seminar/Workshop on Company Standardization, the lecturers being drawn from the Bureau itself. The event has been very popular among the industrialists in Kenya, although the upper hand of the foreign element in the investments has been uncooperative in most cases.

In newly industrializing countries, the system of standardization should be considered the most effective means of management of the national economy and should assume a compulsory status. The first and foremost problem is manpower availability. Consultancy services are a potential source of lots of knowledge. Every foreign venture should be required to provide local manpower that is trained to understand, to run, and to operate that sort of venture and that process. Otherwise, there is no way you can industrialize the developing countries. Investment agreements should be geared towards a genuine takeover by indigenous personnel. Further, the traditional habits and social standards of the people should be respected and maintained. The United Nations should make it compulsory that all members have a standards organization. This is the only way we can create a unified system or unified order, all over the country.

Our future is based mainly on the assistance we can get from industrialized countries. I hope that we shall have a more humane cooperation, that we compromise and get these things done, for the benefit of all of us, as a human race. (J. E. Owino-Okwero, Kenya Bureau of Standards.)

3.7 The real work on standardization in the Sudan has been started recently. In the last two years the Department of Standardization and Quality Control has contacted several regional bodies for help in establishing an ideal national standards body. The final work in this respect is being carried out by the U.S. NBS and AID, the Arab Organization for Standardization and Metrology, and the Department. We hope that the recommendations of this study will be implemented directly. (A. Suliman, Sudan).

3.8 Our objectives in industrialization were two-fold, first, that Tunisia's entire industrial production should be increased, second, that production should be geared toward more efficient economic and social use. To this end, standards were developed for processed products and those set for agricultural and natural products were improved. A standard is the means, the tool that you have to have before all, why you have to do research. It is a reference resulting from reasoned collective choice, with a view to be used as a working basis for the solution of repetitive problems. A proposal for establishment of a single, central National Institute of Standardization was sent to the Tunisian Government last month, and we hope for its early approval. The national development and industrialization programs of Tunisia remain widely open to foreign technologies, but must, at the same time, favor and encourage the national aptitude for invention and innovation. It is easier to say than to do it, to industrialize a country. So we have to go step-by-step, but we have to go. We can't stand still. (A. Bouhalila, Laboratoire Central, Tunisia.)

3.9 The impact of standardization on the Saudi economy is immense. The great demand for goods in 1974-76 allowed for the importation of very low quality products, and Saudi Arabia became a dumping ground for factory rejects and substandard products. It was during that period that the Saudi Arabian Standards Organization played a great role in protecting consumers, guiding the businessmen, and helping the economy.

One of the big problems that we are facing at SASO is that of "image". It is not only the laymen who don't understand standards, but many in the government itself. Other problems include the fact that qualified technical and administrative staff and research and development laboratories are not readily available; and standards have to be drafted by SASO due to the lack of free qualified experts in the country. The most effective way by which the industrialized countries can help is by applying certification and quality-mark systems to all exported products. (Dr. K. Y. Al-Khalaf, Saudi Arabian Standards Organization.)

3.10 The long-term objective is to improve the national economy by strengthening standardization and quality at the in-plant and national levels, which will help to improve the quality of locally-produced goods, make the use of local raw materials more efficient and reduce costs, help to ensure fairness in trade and commerce, and help in the control of imports and promotion of exports. Short-term objectives fall under the headings of standard specifications, testing, quality control, legal metrology, information center activities, training of national personnel, and participation in regional and international standardization activities. (R. B. Halteh, Directorate of Standards, Jordan.)

3.11 It is absolutely correct to point out that standardization is a business function. At the same time, there is, in all the ISO work, a spirit of compromise and concession, which means that in fact agreement is reached and positions are not polarized. As far as the large majority of the ISO standards are concerned -- test methods, terminology, sampling -- it is possible for these to be taken over directly and integrally as national standards. Both the Germans and the British are following this course, so it is not a matter of the size or level of development of the country. Today, standardization is attracting increasing political importance. It would be a tremendous pity if the political impetus that is going to be gained from the United Nations Conference were not to be spread also into the area of standardization. (Dr. R. W. Middleton, International Organization for Standardization, Geneva, Switzerland.)

4.1 Quality control and its related disciplines have played a significant role in bringing about an improved standard of living for the industrialized countries and those rapidly reaching that status. These same concepts and disciplines will likewise be of great importance to the developing nations. Quality control is now widely used in almost every type of industry in most countries of the world. It has proved to be effective

(1) in improving the quality of products, including life and reliability,

(2) in raising the productivity of manufacturing processes,

(3) in reducing manufacturing and other costs, and

(4) in timely deliveries and in determining the marketability of products and services.

However, many developing countries have yet to promote, utilize, and benefit from quality control on a national scale. This requires

(1) Strong national leadership and a national plan.

(2) Establishment and support and publicizing of a national standardization effort.

(3) Governmental and commercial compulsion for reasonable levels of quality.

(4) Information exchange media.

(5) An extensive training program.

(6) A program to promote public awareness of quality, safety, etc.

(7) A national product quality certification program.

The strong temptation to simply observe what has worked in one country and then apply it, unaltered, in another, should be resisted. (Prof. K. S. Stephens, Georgia Institute of Technology, USA.)

4.2 The Singapore Government's policy to accelerate industrialization was based on the premise that it will be faster and less costly to benefit from the experiences of others. An aggressive policy of attracting investments, particularly from the multinational corporations, was pursued. Singapore promoted quality control by the following mechanisms:

(1) The presence of multinational corporations.

(2) The introduction of a national certification scheme.

(3) The formation of a professional organization of quality control practitioners and production engineers.

(4) Government support for products certified under the national certification program.

(5) The policy of pursuing governmental entrepreneurship where the government invests in a number of manufacturing operations.

(6) The restructuring of the educational system towards the scientific and technical, and later, the provision of industrial training.

(7) The provision of specialized quality control awareness programs and courses for industry.

(8) Nation-wide campaigns to promote quality as a way of life.

In Singapore we have chosen to establish institutions to meet expressed needs, not just with the hope that needs can be created. In institutionalizing quality control, we have given priority to establishing an attitude or philosophy in the minds of the people, which has become a value, and is becoming a tradition. (Dr. Lee Kum Tatt, Singapore Institute of Standards and Industrial Research.)

4.3 Barbados embarked on a program of industrialization about 10-15 years ago. Improvements in national metrological services are necessary if national quality control goals are to be met. Our needs fall in three categories:

(1) Training of personnel, at all levels.

(2) Establishment of appropriate laboratory facilities.

(3) The acquisition of appropriate machinery and equipment for testing. This is a major difficulty; the available instrumentation from abroad tends to be too elaborate and too expensive, and not adapted to our climatic conditions.

When in 1972 the Government of Barbados decided to commence establishment of the Barbados National Standards Institution, it was obvious that an integrated approach to the problems of modernization in industrial development and standardization had to be taken, so that the scope of this Institution encompassed both the establishment of an up-to-date system of legal metrology and the transition from the Imperial system of measurement to the metric system. (Dr. J.L. Tudor, Barbados National Standards Institution.)

4.4 In the developed countries, the markets are critical of the quality of goods and services, while in the developing countries, such as Ghana, preferences for products and services are dictated by the price. The result is a continuous degradation of quality. The poor person thus gets less and less for his money, and becomes poorer and poorer. Quality control methods, where they are in operation, are often inadequate. The available scientific and technical infrastructure is also usually insufficient to provide the necessary technical aid to the factories.

Manufacturers do not understand what quality control is all about. Importation of low quality raw materials can only result in low quality products. One will only expect considerable changes in these problems when the economy shows definite improvement.
(A. O. Ntiforo, Ghana Standards Board.)

5.1 The first item for the agenda for the UN Conference on Science and Technology for Development is the choice of technology, the appropriateness of it, the obstacles to the choice of technology. The second major agenda item addresses the institutional arrangements for the transfer of technology, and it seeks for new forms of international cooperation. The third question is how the existing United Nations system can be better used to facilitate transfers of science and technology and to help build up the indigenous capability. Do we have adequate machinery at the United Nations without creating new institutions there?

You cannot separate science and technology out of the economic setting. A new view which is gaining fashion is that growth in industrialized countries may be strongly affected by growth in the developing countries. In 1977, 35% of total U.S. exports and 40% of manufactured exports went to developing countries. The U. S. is approaching the UN Conference in the belief that it can find ways of ensuring that developing countries will derive greater benefits from science and technology, and ways of enabling developing countries to contribute to the world's scientific knowledge and technological know-how. One possible mechanism is the proposed U.S. Foundation for International Technological Cooperation. (Ambassador Jean Wilkowski, U.S. Coordinator for UNCSTD.)

6.0 Technology, in essence, cannot be adopted, it has at the least to be adapted, and ultimately you have to innovate. It is necessary to develop people who cannot only adapt but also innovate. It is also necessary to develop an attitude in the workers and in the entrepreneurs, from top to bottom, to identify and move to correct problems when they see them. We are not really transferring technology. We are building a system in which our choices are in part to take from outside and in part to build from inside, to contribute to growth. It is only going to work if it is tied in with and contributes to the growth of local resources, if it supports local objectives, and if it enables us to build up the technical and innovative skills of local personnel.
(W. Armstrong, International Management Development Institute, New York City.)

6.1 The main problems of Turkey in industrial development have stemmed from an insufficient number of scientists and technologists, lack of know-how, insufficient capital for investment, and large deficits in the balance of payments. In developing countries, the initial problem has been to build sufficient industry to supply the nation so that the volume of exports can be reduced. Only through persistent, productive, and efficient research can the differences between the developed and the developing nations be eradicated. The following shortcomings with respect to scientific and technological research efforts are prevalent:

(1) Only a small fraction of GNP, usually less than 1%, is allocated to R and D. The percentage of the population involved is much too small.

(2) Sufficient coordination may not exist between the basic research activities in universities and research institutes and the productive sectors.

(3) The productive and managerial staffs do not understand the importance of research and its potential problem-solving applications.

(4) Research work, when undertaken, is often poorly supported.

In order to meet the requirements of economic development and social progress, weight should be given to research in technology, organization, and control, directed toward lowering investment and operational costs while increasing output. Purchasing manufacturing plants on a turn-key basis forces the purchasing nations to follow technological advancement from behind, never being able to catch up with the advanced countries. Indigenous technological development is essential to resolve this situation.

For many years the Turkish Standards Institute has tried to create a metrology laboratory, but has not succeeded. This is creating a serious weakness in the technical facilities available in the country. Correlation of measurements at national and international levels is difficult and expensive. Certification in the international markets would have no value, because the accuracy of the measurements cannot be guaranteed.

A national quality control system project was started in 1977, which will greatly contribute to the development of Turkey in this long-neglected field. A preliminary survey revealed that "the concepts of industrial quality control are not fully understood by most industrialists nor by many of the official or semi-official testing organizations. There are no trained or experienced QC personnel in anything like the numbers which would be required in the event of a rigorous

policy for in-plant QC being pursued by a national QC system."

It takes a lot of money and effort to develop a new process, a new product, or a new method; and an organization is not to be expected to hand this over to others without a profit. If we cannot get this technology as we wish, it's not their fault. It's our fault, that we have not handled this research ourselves, or we are not willing to pay a sufficient amount to such firms. The policy for technology transfer should take into account the distinction between products for export and those for domestic consumption. The former requires technology sufficiently advanced to allow effective competition internationally. For the latter, labor-intensive technology should be preferred to enhance employment. Protection of national interests at the utmost level has to be considered before deciding what areas and what technologies require or even tolerate foreign investment. The tendency in most developing countries is to import sophisticated machinery, computers, and other fancy equipment; this constitutes a waste and should be prevented. The efficiency of complex equipment is generally low due to the lack of properly trained technicians.

Mismanagement and poor cooperation among various agencies have also acted to prevent a higher rate of development. This is usually the case in developing countries where available potentials are not efficiently used due to bureaucracy, poor quality of management, and lack of cooperation. Government investments in industry and business in the developing countries should be discouraged, simply because any enterprise so created is generally inefficient, over-staffed, and unprofitable. Unfair practices by unions or management should be prevented in order not to endanger the country's development.

It is most important to create conditions in which a continuous development can be achieved. We have to make sure that the conditions we create in the country open the way for industrial development. The most important contributing factor is the education level, which needs to be well balanced among theory and practice, science and technology, and basic research and application in engineering. The young generation in a developing country should be taught to appreciate working without shame or embarrassment. The desire to work and the sense of responsibility for development of their country must be introduced. Turkey has made great efforts for development, particularly in the last 25 years. The people, considering industrialization as a national duty and for prestige, sacrificed a lot for its success.

Industrialized nations should take greater interest in the development of the industrializing nations. There is needed a new agency to assist these nations in technology transfer quality control, standardization, metrology, certification, and marketing. The proposed agency should form a triangle with the International Monetary Fund and the World Bank, to contribute technical and managerial assistance in the realization of industrial development projects. (Prof. T. G. Somer, Middle East Technical University, Turkey.)

6.2 The Industrial Revolution is now entering a most promising and complex phase as it becomes global in scope. Most of the industrializing countries are newly independent and intent on shaping strategies of industrialization suitable to their own goals, needs, and values. These national orientations are to be matched with a world situation in which the international mobility of technology and resources is creating new forms of interdependences among nations. Technology, in the sense of the practical application of invention and discovery, is as old as mankind itself. What is new is the science-based technology, the outcome of industrial research, a phenomenon of the present century. Accordingly, there has been a considerable urge to transfer this technology to the lesser developed countries in the last 50 years or so.

A development capability index has been derived empirically. It is approximately the square root of the product of (gross national product) times (per capita gross national product). In other words, both the gross national product and the number of people over whom it has to be spread are important. A technology transfer function has been devised which is the product of the development capability coefficients of the two countries involved.

The symbols of modernity, in the form of steel mills, chemical plants, automobile factories, and squadrons of military aircraft, can be purchased on the international market; but development is a complex social process, which rests in large part on the internal innovative capabilities of a society. It has been repeatedly found during the last two decades, that in spite of all the transfer of technology, the gap between the developed and the developing countries has consistently been increasing. Technology transfer alone cannot bring any developing country up to a level with the donor countries. One of the

major tasks facing the developing countries is to create, nurture, and more often than not, rehabilitate their internal capacity to invent and innovate.

Introduction into Pakistan of capital-intensive technologies of the West often has raised more problems than it can solve. In agriculture, the need for proper adaptation of imported technologies has been generally recognized. But in industry and large-scale construction, this is not true. Appropriate technology should promote national and local self-reliance. Some criteria for appropriateness include:

(1) High employment potential.

(2) Low investment required, as compared to the level of local income.

(3) High potential in utilizing domestic material resources.

(4) Strong linkage to local industry to satisfy the actual needs of industrial clients and markets.

(5) Higher productivity than existing traditional technology in the same field.

(6) Easy maintenance.

(7) Compatibility with prevailing sociological conditions in the locality.

A people-oriented development programme requires an emphasis on both economic growth and social justice. Technology is needed for production by and for the people. We need to develop and appreciate the large pool of technical expertise that is available in our countries; we are consciously drifting away from those industries in which we have a strong indigenous base. There is a distinct reluctance on the part of industrialists to make proper use of the indigenously developed technological capabilities. They seem to have an ingrained suspicion of anything home-grown or home-developed.

For a developing country to emerge from the state of under-developedness and forge ahead of others, it is necessary for it to progressively develop a body of highly motivated technologists, scientists, and technicians, possessing a belief in their own destiny. While the West needs research on which to build its high technology, most of the technology the developing world wants already exists, and the immediate need is to learn to select, adapt, and use it. More and more emphasis needs to be placed on the production and utilization of engineers, in contrast to scientists. What is really wanted is an optimum mix of intermediate technology and high technology at any given time, and this is where the developed nations can help the developing ones. We need national centers for technology transfer and appropriate training, mechanisms for assessing the applicability of a particular technology within a country and for comparing it with all the other technologies that are available; encouragement of local R, D and E; and reversal of the brain drain to put local talent onto projects that have immediate relevance to their countries. (Dr. M.M. Qurashi, Appropriate Technology Development Organization, Pakistan.)

6.3 The knowledge and application of sound management principles is really the basis of and a firm requirement for industrializing countries. Technicians and administrators must be able to plan, organize, direct, staff, and control the operation. Poor management is probably the single greatest problem in industrial development. (Dr. J. A. Slater, U.S. Department of the Interior.)

7.0 The tremendous reservoir in the United States of know-how in commercial industrial technology is not really being made as available as it might be to the developing world. Mechanisms for utilizing the private sector must be looked at.

Three aspects need particular attention:

(1) The imperative of sound planning, national and sectorial, and project design.

(2) Better management and improved technological developments in existing industrial plants.

(3) Promotion of small or medium-sized business. (A. R. Baron, United Nations Department of Technical Cooperation for Development, New York City.)

7.1 It does appear evident that much more can be done by the United States to facilitate tapping by the Third World of the vast technological know-how of America in fields of industry. I hope therefore that this Seminar will lead to concrete recommendations for developing public and private mechanisms to augment the flow of U.S. industrial technological know-how to the developing countries. We need to help the Third World introduce and adapt technologies (industrial and others) which are people-oriented, which develop self-reliance, and which foster the new international economic order.

The developing countries place their hope and trust in total cooperation in the struggle for freedom, dignity, life, and for the know-how to fight against hunger, illiteracy, poverty, joblessness, sickness, and death. "Let us not lose sight of the fact that, for the first time in history, we have at our means the resources and ability to bring about a better life for all peoples." (I. S. Djermakoye, Department of Technical Cooperation for Development, UN, New York City.)

7.2 The main obstacle to the complete "nationalization" of the technology involved in the real cases cited, is connected with the lack of capability in the product design and engineering function. This capability can only be developed through an R, D & E approach, that is, through the interaction of engineering groups with the R & D capability. The knowledge needed to acquire the different necessary industrial technologies has consisted essentially of sound engineering knowledge. But the application of each industrial technology has always required some local research, even when this technology was wholly purchased abroad, because of the necessary knowledge of the most diverse materials needed to build and operate the industrial plants. To operate an industrial plant you also must have available locally a large diversity of skilled personnel, like mechanics, tool makers, electricians, plumbers, etc. You also have to consider the organization and maintenance of some local institutions whose support may be of the utmost importance to the practical use of those technologies. In the case of industrial development in the area of Sao Paulo, an engineering school and an industrial research institute, both stressing the need and the advantages of objective laboratory measurements and experimentation, have been the key local institutions. Very few of the foreign and multinational companies located there have done anything to help the strengthening of those institutions.

Since the 60's there has been a mounting preoccupation with the growing external technological dependence of the country. Some of the more objective preoccupations are related to:

(1) Problems with engineering projects contracted abroad, which may lead to the importation of components and equipment that could have been made in Brazil.

(2) Problems with licensing and technical agreements, which may contribute to capture of Brazilian private industries by foreign companies.

(3) The tendency for unhealthy perpetuation of some techical agreements.

(4) The lack of ready-made technologies for the exploitation of the non-conventional natural resources of the country.

Brazil has now a good number of fluorishing research institutions, and a bigger long-term plan of cooperation would make them all profit from the experience, the capability, and the ingenuity of the American universities and research institutions, in the development of a sound R, D and E basis for my country. (Dr. Alberto Pereira de Castro, IPT, Sao Paulo, Brazil.)

7.2 The negotiation of the agreement for the technology and its transfer is a threshold, and the effectiveness with which the principal actors discharge their responsibilities will have a substantial impact upon the effectiveness of any particular transfer, and the contributions of the technology to the industrialization process. There are obvious conflicts of interest inherent in the situation before the negotiations begin. The host country is, to a degree, dependent upon the supplying transnational enterprise for the technology needed. Yet that enterprise is seen as beyond the control of any government, transcending the soverign interests and limits of the host country. The adoption by both parties of a long-term mentality will help to provide a climate of stability and mutual benefit. The transnational enterprise must view the transaction as a partnership, whereby it becomes a citizen of the host country, undertaking a commitment to its social and economic development, in return for a satisfactory profit. The host government should exert dedicated efforts to maintain a climate of stability so that the transnational enterprise does not believe that it will place in jeopardy its human and material resources. The apparent inequality in bargaining power between buyer and seller in this situation arises in part from inequality in knowledge. Increasing the indigenous knowledge base, the theme of this Seminar, is thus a prerequisite for ultimate equalization of bargaining power. No technology is appropriate if the infrastructure is not capable of receiving it, absorbing it, and utilizing it effectively. (R. J. Radway, Attorney, New York City.)

7.3 Overemphasis on technological growth has given rise to serious imbalances within the global perspective and to problems in certain areas. Three of these problem areas are in development, where we see unemployment, urban congestion, and other drawbacks; in ecology, where we have pressure on and wasteful uses of resources; and in security, where an unnecessary amount of resources is being put into military expenditures. Three other factors add further complications: the increasing population, the recognition of a finite limit to resources, and an awareness of a growing global inter-relatedness. Technology it not an end in itself, and it is not the only means toward the specific goals of a country. We must be willing to consider the need for a country to want to emphasize cultural diversity and other such things. (J. Gudaitis, Center of Concern, Washington.)

8.1 Why is the United States involved in this great exercise? Because there is benefit to be received by those in the United States who have technology to transfer. And because, in doing what we are proposing to do, or are involved in doing, we are doing something for humanity. Because if we uplift the nations of the world, everyone stands to benefit. (Dr. H. I. Forman, U.S. Department of Commerce.)

8.2 It is not the English that you have to understand. It is the silence that you must learn to interpret. Technology only resides in human beings, not in licenses, papers, and so on. So, we can only transfer this technology from one human being to another. And if there are too many cultural differences, so that we cannot even understand each other, then I don't see how technology can be transferred. An approach would be, how can the more developed help the less developed, and so on? The gap between us will be smaller.

For developing countries to stay alive, we need something to live on, and something to live for. (Dr. Lee Kum Tatt, Singapore Institute of Standards and Industrial Research.)

8.3 Technology transfer has its people-to-people elements. Any plan that does not recognize this and take it into account, can waste a precious opportunity. (Dr. A. Small, U.S. Department of Commerce.)

8.4 The phrase "technology transfer" has given rise to much faulty thinking. It implies the transfer of a process from a developed country to a developing country with the expectation that the process will work as well in the developing country as it does in the developed country. This simplistic approach does not begin to suggest the complexity of the subject, nor does it take into account the high degree of psychological receptivity and technical capability required for an effective transfer.

The phrase is also faulty because it implies the initiation of a process from the developed to the developing country. This ignores two basic responsibilities that repose in developing countries before the notion of technology transfer or technology adaptation can be initiated. The first responsibility for the developing country is to determine what sort of society it wishes to become in terms of the development of its human and material resources. Having made that decision, the developing country must then determine the sort of technology it requires to achieve its economic and social objectives. It is only after these two sets of fundamental decisions have been made, that developed countries may enter into the picture.

Developed countries can sometimes provide resources, skills, and analytical capabilities to assist developing countries in making rational technology choices and in developing the kinds of human and institutional resources they need. In this context the U.S. has much to offer in both the public and the private sector. The kinds of training and services offered, for example, by the National Bureau of Standards in metrology, standardization, and quality control will probably be of increasing interest to developing countries. We must try to organize ourselves to provide these and other kinds of educational and training services more efficiently and more effectively than we have up to now. (J. A. Stromayer, Deputy U.S. Coordinator for UNCSTD, State Department.)

SECTION 1 - KEYNOTE SESSION

Chairman: Dr. Ernest Ambler, Director, National Bureau of Standards

PAPER 1.1 - WELCOME AND INTRODUCTION

Dr. Ernest Ambler

It is my privilege to be chairman of this first session, and it is also my distinct privilege to welcome you all here to the National Bureau of Standards. We are very pleased to be hosting and cosponsoring this Seminar.

It is very gratifying that there are so many representatives from diverse groups here this morning, from the United Nations, from over 20 individual nations, from several groups within the government of the United States, and from American industry. This augurs well for a very interesting conference with very strong interactions and is an indication of the importance of the topics being explored this morning. These topics include metrology, standardization, quality control, technology transfer, and technical management.

In other words, we will be dealing with elements of the technological infrastructure needed to support industrial development. The infrastructure, or as it is called in the official title of this program, "knowledge base", is an indispensable part of the development process. Without it, the best laid and clearest plans for industrialization would be very badly impeded. In the next two days, you will explore many aspects of the knowledge base. The information and ideas that are discussed here will help all of us better understand the needs and opportunities that exist, and your discussions will serve as background material for the preparations for the United States positions to be presented at the United Nations Conference on Science and Technology for Development.

So we are very glad that you are here, to share with us your experience, wisdom, and insight.

PAPER 1.2 - OBJECTIVES OF THE SEMINAR

Dr. Jordan J. Baruch
Assistant Secretary for Science and Technology
U.S. Department of Commerce
Washington, D.C.

This is a very exciting conference to me. The whole concept of the growing industrialization of the world is probably one of the strongest forces for lasting peace that we have. Politicians have their way of approaching peace. Scientists and engineers, I think, have a far more constructive one, and that is by the gradual elimination of need and by meeting the requirements of their individual societies.

Unfortunately, industrialization, resting as it does on technology, is often very difficult to achieve with any degree of rapidity. There is a story--I don't know how apocryphal it is--about a United States company that set up a large conveyor belt system for moving goods out of some mine, a long line of rubber on rollers, and some years later I was told that a visitor to that site found the conveyor belt standing absolutely still, but the camels which were carrying the materials from the mine, were very happily walking in its shadow.

I think this story typifies some of the problems we have when we discuss industrialization, and that is, the need for an infrastructure: "Infra", meaning not lower in the sense of importance, but lower in the sense of a foundation. Very often when we hear plans for industrialization, or for technology transfer, as it is often called, from people in the United States or people in other countries, it brings to my mind the picture of a group of people trying to build an apartment house starting on the third floor and working down to the foundation. It's a brilliant idea, but very difficult to implement.

The series of meetings that you will be engaged in here addresses the question of building the foundation for that industrialization. I don't want to put too much pressure on you, but let me just say that without you, nothing is going to happen. Let me repeat that: *Without you, nothing is going to happen*. There is no way that the politicians of the world can produce technology transfer and the industrialization of many countries without first your groups building the infrastructures that can keep such industrial sectors alive.

Now there are many kinds of infrastructure that are needed for the growth of industry. One is the physical infrastructure: The roads, the power system, the telecommunications operation. There is also a financial infrastructure: the banks, the equity markets, the venture capital availability. We are not going to talk about those today and tomorrow. We are going to talk about the science and technology infrastructure. I would like to point out, however, that when you get finished with your meetings here, you will have covered only part of the subject.

Let me give you a working definition of technology that I have found useful, and that may be useful to you. "Technology is that combination of the arts and sciences whereby industry creates the useful goods and services for a society." That is a generally used definition in many areas of study in the United States, but I would like to stress the existence of the word "useful," the "useful goods and services". That implication of *use* requires not only that the technology grow, but that the knowledge of the match of that technology to the needs of society grow in parallel. So many of you will be extending your thinking from the area of the basic technological infrastructure to the tasks of matching that infrastructure to the fundamental needs of your society.

Now you know, this group has to be one of the most underappreciated groups around. I have tried to figure out why that is. I think in part it is because--well, I can only talk for the United States--engineers in this country were always considered to have dirty fingernails. And if you had dirty fingernails, you were not invited to the kind of parties around which the power structure of the political world grew. I have a feeling

that there is that same kind of a cultural problem in many countries. I know in certain South American countries, engineers are considered to be hand workers and, therefore, not the kind of people that one gets into the management of a corporation. Those days are changing. And they are changing for a very simple reason. They are changing because the countries and the industries recognize that in our modern technological era we cannot progress without the engineers and scientists.

We are not going to cover even the technological infrastructure in any great detail in the next two days. What we will be doing is developing a basic understanding among us, and a framework for a continuing series of discussions. This group transcends national borders, and we expect that our discussions will continue for a long time.

This Seminar has been called "The Technological Knowledge Base for Industrializing Countries." I would like to make sure that all of you--and particularly my colleagues--recognize that when one talks about industrializing countries, we include the United States of America. Dan Bell, a sociologist up in New England, did a great dis-service, I think, not intentionally, to the future of the United States by writing about the post-industrial society, as though we were finished with the process of industrialization. It reminds me of the time back in the 1880's when we had a resignation from the Patent Office because, as the letter of resignation stated, "all of the important things had already been invented, and there was no more need for a patent office." That same nonsense applies to the concept of the United States as a post-industrial country.

An industrial country is fundamentally an entropy sink. It brings order to materials, to information, and tne day we forget that, we start a long down-hill slide. So I would like to stress that the United States is not only an industrializing country, but I hope my colleagues will also recognize it as a developing country.

Now, the National Academy of Sciences has done a report to help the United States form its position paper for the UN Conference. The Fund for Multinational Management Education has also done a report. None of these really recognize the importance of the scientific and technological infrastructure.

As you get into that infrastructure, in the next two days, you will find a great dissatisfaction and frustration. First of all, we cannot examine all of the infrastructure. We cannot examine electronic instrumentation, the service part of the infrastructure, the maintenance system of a country. Most important, we cannot examine the vital link that I mentioned earlier, between the technology, the need, and the delivery system of the country. But not only is it impossible to examine all of the infrastructure, what we do examine we cannot examine in detail. We are going to be examining four parts-- measurement science and technology, product standardization, quality control, and agreement negotiation. Each of these is vital to the transfer of technology, and each could comfortably take about a month of discussion of the intensity that you are going to be having in the next two days. I hope that most of you will get a sense from this meeting that you are part of a new and vital network that is international in nature, that parallels the political network, but one that can make extraordinary substantive contributions.

The meeting program is structured to bring together participants from governmental organizations, country representatives from developing or industrializing countries, and representatives from organizations that have been involved in the actual technology transfer process. We have asked Herb Fusfeld, who has been involved in this for a long time, to start the meeting off, with a general address to the question of the development of an infrastructure. I could say some things about each of the areas, but I think I have talked long enough. What I would like to do today is to encourage you, not only to get vitally involved in the next two days of work, but to make sure that this network that you are putting together today persists for a long time, and becomes a good source of communication channels, because the problems we are addressing will only grow over the next few years rather than decrease. So I wish you well in your deliberations and in your joint activities, but, most importantly, I wish you well, and a welcome to the community of infrastructure builders that will make industrialization possible throughout the world.

PAPER 1.3 - EXPANDING HORIZONS: TECHNOLOGICAL KNOWLEDGE FOR INDUSTRIAL TAKEOFF

Herbert I. Fusfeld, Director
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New York University, New York, NY

There is no exact historical analysis by which the development of the present industrialized nations can be used as examples for a comparable development of countries now in the process of industrializing. Apart from the truism that each country is different, the simple fact is that we are considering today the question of the best way in which a technology base can be developed within industrializing countries in a world where industrialization has already occurred for many countries. While we are all still developing and industrializing, there are such different levels that have been achieved that we have to look very carefully at the situation today, where we do have a major base of industrialization present in many countries; against that background, we must consider what newly industrializing countries may do.

There are, of course, guidelines and clues that can be selected from the industrial development of the Western world and of the more advanced socialist countries that can be drawn upon to the benefit of newly industrializing countries. But these are not always obvious, they always require tailoring to the culture and capabilities of the developing country involved, and we have both good and bad examples to consider.

The principal distinction to keep in mind is simply this: the industrialization of the Western world took place *within roughly the same time period* as the development of the technology that was part of that industrialization and with constant strong interactions between these two developments. The industrialization of developing countries today is taking place within a world that contains a complete spectrum of technology, from windmills to satellites.

This simultaneous progression of industry and technology in the Western world was, in the broad sense, evolutionary, no matter how rapid that evolution may have seemed at times. They proceeded in a crude *balance*, a key word which I will emphasize again and again. The industries and markets in place created needs for technology and at the same time provided a mechanism for exploiting new advances. A growth cycle was in operation by this feedback characteristic of the evolutionary industrialization occurring.

Newly industrializing countries today appear to have an enviable choice for selections from the available reservoir of technology in order to build a base for whatever industrialization is desired. My concern is that such selections and planning may occur based on the superficial relation between technology and industrialization that can be observed in the developed countries, without adequate understanding of the more complex factors present. These factors provide the cement that brings together technology and industrialization in an effective relationship. An understanding of this total system is necessary in order to guide our approach to building an appropriate technological base.

The developing countries approach the world market of technology much as a hungry man approaching a smorgasboard banquet. Where to start and what to emphasize? But the situation differs from the experience of Western developed countries in two important respects:

1. There is today a strong element of national planning in selecting both the technological structure and specialties, and the desired areas of industrialization to be supported by, or to flow from, this technology.

2. Any technology selected for emphasis by an industrializing country will almost certainly have been developed and put to use somewhere else so that a "technology gap" exists by definition.

Keeping in mind these two characteristics, one should then consider two principles that can help developing countries to avoid the disadvantages contained in them and to build

upon whatever flexibility their situation implies. First, there should be a clear understanding of the industrial objectives for the country that is based realistically on the internal capabilities, the world markets and resources, and the time required to develop a technical base compatible with these objectives. Second, there must be development of indigenous technical capabilities to adapt and then to emphasize those areas of technology that relate most closely to the evolving domestic industrial efforts arising from the national objectives.

Without going into particular technical subject areas, we can translate these broad principles into somewhat more specific guidelines. There are different categories of national objectives related to industrialization, and they call for at least different technological structures, most probably for different technologies. I find it helpful to think of these national objectives by analogy with the several categories of objectives of a corporation. Each objective requires not merely different technologies but a different *balance* of capabilities to form an effective system.

A corporation generally develops technology to meet one or more of these objectives:

1. Cost reductions within its existing business and operations.

2. Improvements in present products and/or development of new products for present markets.

3. Development of new products for new markets and for development of wholly new businesses.

There are, roughly, comparable categories of objectives for industrializing countries, namely:

1. Strengthening of existing national structures in natural resources, manufacturing, and services.

2. Expansion or development of industries to provide the needs of domestic markets.

3. Expansion or development of industries intended to create exports.

These can be compared in a single table in terms of the three classes of objectives:

OBJECTIVE	CORPORATION	COUNTRY
Strengthen present base	Lower costs	Strengthen national structures
Expand present base	Improve products	Provide for domestic markets
Develop new bases	New products for new markets	Develop exports

As we think of the problems faced by industrializing countries in terms of the comparable corporate situation, the simplified table above suggests the following:

1. The technological structure called for must be identified with some industrial structure already in place or whose establishment is well defined as to requirements, markets, and ability to implement.

2. It is clear that the objectives listed can be achieved by a variety of mechanisms such as investment in new plants and machines, different allocation of labor, cooperative agreements with other countries. We are concerned here only with technology, therefore we must really consider the technological structure that can be most effectively integrated with the capital, labor, and management available to best achieve each objective.

3. There are different time scales associated with each separate objective. The time for developing or adapting a desired technology for a given objective must be compatible with the time in which it is needed, an obvious but often ignored criterion.

It is clear, then, that a newly industrializing country may appear to have a choice of all the technology in use within the developed countries, but it must in fact operate within the constraints and guidelines

of its own position and objectives in order to use technology productively. The primary goal is not technology but balance, and the measure of success is not the number of technical personnel or even technical contributions but rather the effective integration of technology into a workable economic system.

Thus, a critical factor that must be present in any industrializing country is the ability to manage technical resources. Not only is technology merely one of several approaches to achieving industrialization, but there are many approaches to achieving a technology base. If a developing country could afford to buy or to train just one professional person, that person should be a technical manager--not an educator, not a scientist, not an engineer, but one who understands and can integrate the contributions of the others.

The particular importance of technology management is that there *are* choices to be made, both choices *of* technology and choices of mechanisms for acquiring technology. Again, there is an analogy with the operations of a private corporation. Each company develops the most efficient process for acquiring the technology needed which is most compatible with corporate resources. That is, technology can be developed in company laboratories, it may be obtained through licenses, or there can be some form of joint venture with another corporation possessing the technology.

Thus, an industrializing country can use combinations of any number of mechanisms including:

1. Development of domestic know-how, in the home country or abroad, through exchanges of personnel.

2. Cooperative technical programs with private or public organizations from developed countries.

3. Development of a basis for companies from industrialized countries to establish manufacturing plants.

4. Joint business ventures with private companies from industrialized countries.

5. Mission-oriented technology institutes, focussed on specific industry sectors with cooperation of the private sector of developed countries.

These mechanisms sound as though I place great reliance on the involvement of private corporations, and I do. But I am not suggesting that the industrializing countries lose control of their development, nor do I have any illusions that cooperation from the private sector will be provided simply by asking. However, these several mechanisms can expedite the development of a technological base if both the industrialized and industrializing countries understand and accept the objectives of each.

First, the use of cooperative arrangements with private companies should be in *addition to*, not instead of, the development of domestic technical skills. There must be some minimum number of skilled technical people within the country, otherwise it cannot be considered as an industrializing country. In any event, particular skills necessary for the early stages of industrialization must be the first priority in order to encourage cooperative ventures as an acceptable and practical option.

Second, instead of attempting to separate out, or "unbundle", technology from its related business, every effort should be made by the industrializing country to attract a "business package" through some form of cooperative venture with the private sector of the developed world. Again, I am not suggesting this simply because I believe in the effectiveness of the private enterprise system, which I do, but because a complete venture which includes manufacturing and distribution activities will:

1. Provide a mechanism for the technology to contribute to the domestic economy.

2. Create an infrastructure of supporting technical skills, including inspection, measurement, quality control, and maintenance.

3. Identify and motivate the technological base needed to improve and strengthen the business structure.

4. Develop an income base to finance a stable, long-term technological effort, in other words, create the same kind of growth cycle which has been built up in the Western World.

Third, there should be a deliberate effort to develop close ties with one or more industrial sectors of the developed countries in order to create a reservoir of potential cooperation from those enterprises for training, for exchanges of personnel, and for establishment of technical institutes intended to provide the developing country with the ability to expand its own technical base in those industry sectors.

My emphasis throughout this paper on the potential roles of private companies as a powerful aid to industrializing countries in building a technological base should perhaps be clarified and put into perspective. After all, most discussions on the role of technology in development emphasize training, health, agriculture, information exchanges--that is, the general technological infrastructure. I do not mean to ignore or minimize these activities.

To explain my emphasis, let me return to the earlier comparison between the approach of a private company and that of an industrializing country. The general categories I used were (1) strengthen the present base, (2) expand the present base, and (3) develop new bases. As a broad generality, the first category, consisting in great part of the technological infrastructure, can draw largely upon resources and technology available within the public sector, or at least the non-profit sector. This includes government, universities, foundations, and so on, which are the logical sources for such subject areas as education, public health, and the like.

The second two categories are concerned with active economic growth, and involve manufacturing, distribution, marketing--that the resources needed to use and to *specify* the appropriate technology. And this is a meaningful use of the phrase "appropriate technology". The resources required for these categories are the management skills and the technology which reside in, and are the property of, the private sector.

This distinction between public sector and private sector technology and their roles in different phases of industrialization, although well understood, is rarely stressed adequately. This is why I have placed my focus primarily on the contribution from the private sector.

Without referring to any particular industry or technology, I have attempted to set forth several of the principal conditions that should be satisfied in the development of a strong and effective technological structure. These conditions can be summarized as:

1. There must be an industrial structure to provide feedback that can reinforce and guide both the industry and the technology.

2. There must be a clear understanding of objectives and timing, so that the allocation of technological resources can fit in with the allocation of total resources into strengthening the national structure, providing domestic needs, and developing export markets.

3. There should be emphasis on technology management in order to achieve the most effective mix of domestic technology and cooperation with developed countries.

4. There should be encouragement for the establishment of complete business enterprises in cooperation with the private sector of developed countries in order to expedite the integration of technology into the economy, and provide a basis for selective technical development.

I believe that an industrializing country can profit greatly in all aspects, particularly in its development of a technological base, by becoming familiar with the management techniques of a private corporation. This is why I have stressed the value of cooperative ventures with enterprises from the developed countries. Such cooperative ventures can in turn be pursued most effectively when there is an identifiable company or business unit within the developing country which can interact with its private counterpart from the developed country. While the developing

country must establish its overall objectives, timing, and priorities, the development of specific technological strengths can probably best be accomplished through the independent actions of the separate industrial or business units within the developing country.

The present level of industrialization in the developed countries of the West derives from the two broad factors of balance and time. There is a balance among the complex interplay of technology with those other elements needed to bring its benefits to society--manpower, capital, and an organizational structure. A long time period has been required for this evolution to take place in Europe and the United States, to develop the needed infrastructure, and to evolve the system of feedback and integration that creates the balance.

Industrializing countries can learn the principles for achieving this balance, and the function that balance plays in the use and advance of technology. The time scale can be shortened through sensible and creative cooperation with the industrialized countries--cooperation not just with governments, but with companies.

This cooperation depends in great part on understanding that private companies are concerned with the successful establishment of a total business, not with the building of a technical base as an end in itself. It is my understanding, however, that this is also the concern of the industrializing countries, or at least of those within the country concerned with its economic health. Equally important for this seminar, a successful business both includes and specifies a technological structure. There is no meaningful way to build technology without building a business structure, and there is no quick way to do this without cooperative ventures with private companies.

Other speakers at this seminar will emphasize specific elements that make up a technological structure and case histories to illustrate their importance. I have emphasized the need to relate any technological structure to the parallel structure for its use. The principles for accomplishing this and the technical management required are to be found in the disciplines of modern industrial research and in the operation of Western private companies. It is not necessary for a developing country to copy these practices, but it is necessary that they are understood and *adapted* to meet the specific political and economic structure of the developing country. If the developing country is willing to work with a private company without destroying the business structure which it brings along with the technology, then I am certain that the Western private sector can provide the needed cooperation without undue distortion of the domestic politics or economy. The advantages are mutual, the objectives are compatible. Building a technological structure as such is simply an intellectual exercise. Building a strong and successful economy is a worthwhile human enterprise in which all of us can contribute, and in which the future can work successfully with the present.

DISCUSSION:

Mr. Saul Padwo (Bureau of Domestic Business Development, U.S. Dept. of Commerce):

Dr. Fusfeld described a system which says that technology as a resource by itself is meaningless, unless it is used appropriately as part of the management mixture of tools, where other resources in the management mixture are blended with it. Could we look at a lesser developed community in an industrialized country as being comparable to a lesser developed country, and if that is so, could the mechanisms that we have discussed and examined as being applicable to lesser developed countries in fact be tested in the industrialized countries, for the development of their lesser developed communities?

Dr. David S. Lieberman (University of Illinois):

The question is whether less developed communities within an industrialized country could serve as a paradigm for less developed countries within an industrialized world. I think they probably can. There has been some work in this area. The paradigm is not a simple one, because countries, being

larger in scale, have a different distribution of many of the natural resources, both personal and material. But yes, I think there are very similar problems, within the United States, for example, to those that we are addressing here within the world.

Dr. Edward L. Brady (Associate Director for International Affairs, NBS):

Dr. Baruch has referred to a network of some sort. I would like to ask him to amplify that a little bit, and explain what he meant by the "network of people here".

Dr. Baruch:

This group has gotten together because of a common interest in the development of the industrialization of a wide range of countries. You constitute, in essence, a group with similar technological backgrounds, similar tasks of introducing a technological infrastructure into your countries, and a group that is now connected to each other as a group. When there is a problem in Saudi Arabia, there ought to be a way of accessing the people in the United States, or in any one of the other countries. As we start to see generalities, congruences among our problems, the ability to make two phone calls and reach anybody in the network is extremely important in their *practical* solution. And this forms a good nucleus for a network. You are going to be living together for two days, discussing a common problem, getting to know each other, and I would suggest, collecting addresses and telephone numbers.

Dr. Lieberman:

Both talks in interesting ways touched just lightly upon the whole question of technological education, which I think is inherent as a very important part of this problem. What are the institutions of higher technological education? How are they able to support this growing industrialization? Without this support you are going to have to just give *aid* all the time, instead of having local development be self-sufficient. You then have to think about values, a subject which was also inherent in both talks. So although we may all agree on how to build a bicycle, the question of whether to build bicycles or not, is a very different one. Answers to this kind of value question depend upon the country concerned and the people involved and the time. I don't know how you get these answers with scientific-technological discussions.

Dr. Fusfeld:

It is a very difficult question. You know, right now, we are faced with exactly that problem in most of the preparations for the UN Conference: the question, for instance, of what is "appropriate technology"? Automatically, as soon as you use the word *appropriate*, you have got a value judgment in there. For example, it has looked to some people, especially members of some of the third world countries, as if the idea of using "appropriate technology" is simply a way of freezing in a low-level agricultural status. In fact, they would much prefer to have a highly advanced, industrialized country, and to use very inappropriate technology by our standards. I think they are perfectly right. In other words, it is not proper for people in our country, supposedly trying to be of assistance to developing countries, necessarily to use our value judgments on exactly what technology is needed and what their objectives ought to be. The responsibility for observing what we are doing, picking what you think you need, and adapting it in such a way to fit the organization and the economy of your individual country, is clearly the responsibility of the developing country itself. We cannot set our values on it. And therefore by analogy we cannot suggest a training system, and educational system, unless there is some rough idea not only of the kind of objectives of the country, the kind of technologies they will need, but the *time scale* that they think they want it in. In the past, much of our infrastructure approach of providing institutes and training of manpower, at least in recent years, seems to have ignored the fact that these are 30 year projects compared with some of the demands from third world countries for essentially 2-5 year projects. So, all I can say is, you are right. I am not sure what to do about it.

Dr. Baruch:

I would like to make one observation. In any organization, you find two different sets of activities, which I have tended to label as "goal selection" and "goal pursuit". *What should we do? How should we do it?* In nations, goal selection is primarily a political activity. Goal pursuit is primarily a technical activity. But what is increasingly obvious is that goal selection cannot be done in the absence of knowledge about what is obtainable, and similarly, goal pursuit cannot be done without an understanding of the basic reasons for the selection of the goals in the first place. So, one of the things that is becoming increasingly obvious, is the bringing together of the politico-technical systems in order to continually iterate this process of pursuit--selection--pursuit--selection. In a company, it shows up by an increasing tightness of coupling between the marketing departments and the engineering departments. In a government, it shows up by appointing engineers to assistant secretary slots. I think it is critical that we recognize that those two are growing rapidly together, and will eventually merge.

Dr. Jose L. Tudor (Barbados National Standards Institution):

Dr. Fusfeld mentioned the need to establish mission-oriented technological institutes that address the problems of particular industries. Am I correct in saying that these could be of two kinds? One kind is that which the institutes are established by developing countries themselves, to address their problems, using their own available resources, perhaps with financial aid from international bodies. The other kind would be the type of institutes established by the more advanced industrial countries within industrializing countries, which address problems of interest to both sides. Such problems might be, for instance, problems in solar energy or in developing unique resources. I tend to think of a couple of institutions established in Barbados by various institutes from more developed countries which work in areas that could be of interest to both countries. However, I think that a problem arises in bringing some of the benefits to the people in the not-so-well-industrialized country, in that there seems to be a lack of local participation in these activities. Perhaps you would like to expand on ways in which such types of institutes could be fostered and the benefits shared more adequately, and also on how private industry might possibly fit in establishing such institutes.

Dr. Fusfeld:

I can quote one example that will illustrate the sort of thing that I had in mind. I must confess that I was thinking primarily of the first of your two categories, namely, the one where you have an institute in the developing country, focussed on either the industrial area or some form of mission-oriented problem of that country. The reason I suggested it is because it is a good example of how to get cooperation from the developed countries.

The example I can give you, since I spent 15 years with the Kennecott Copper Company, is that of the development within Chile of a copper research institute. This story has both good and bad examples in it. The Chilean government wanted to strengthen its own domestic base of people and technology and processes, focussed on the Chilean mining industry, which provides them with perhaps 60-70% of their income, very critical to the country. They did not want to be completely dependent upon technologies coming only from the West, which was the case, the research and development in mining having been done in the United States, Canada, and elsewhere. So the concept was good. And they did want to set this up. They wanted to get cooperation from the private sector.

They approached the big copper companies, obviously, and we said, "Yes, we would be happy to cooperate." And why did we say it? Not for the sake of charity, but because we had a major business operation in that country. We obviously wanted to strengthen the technical infrastructure and the local engineering capabilities. In other words, we had a selfish interest in helping them, and it would have helped that country. I use the past tense, if you are watching my English carefully, because this was arranged just

before Mr. Allende came into power in Chile. About two weeks before I was supposed to go down to Chile, Mr. Allende took over, and of course my trip was cancelled. Naturally, the copper companies were thrown out, and this became a Chilean problem only. There was no further help from the Western companies, for many years. Finally, with United Nations help, the Institute was set up. Now, with a different government in Chile, they have again attracted foreign companies to come in there--I must say Kennecott and Anaconda did not go back, but Exxon went in--to open some copper mines for them. Of course they are quite able to call upon any company which has a business interest in that country to help them. And they are being helped.

Now there are several morals to all this. It was a very good concept in the first place, because it did address itself to the kind of growth cycle that I was talking about. There was an industry, they were building up a technology, and the two could strengthen each other. It could have been expedited by help from the foreign private sector, provided there was a *business interest* for that private sector in that country. Believe me, if no American company had any copper interest in Chile, Chile would not have been able to attract a single engineer from those companies to help them.

I think that is something to keep in mind as we are preparing some approaches for the UN Conference, that while there is an enormous reservoir of technology in the private sector of the West, the only realistic hope of getting the cooperation of private companies is when there is a business interest of a company in the country that is asking for it. If there is no business interest, I just don't see how you realistically can expect it simply as a favor.

Miss Winifred Armstrong (International Management Development Institute, New York City):

One of the problems that I see in many companies coming into a developing country is that they bring with them the technology that they are currently using, that they have currently developed out of their own situation, and the kinds of equipment and the kinds of training and the kinds of parts, and so forth, that generally are geared to what we have developed here, and the markets that we meet, that we generate, here. How can the United States and how can the companies help the developing countries achieve the kind of balance that you have talked about, which includes developing technologies which are appropriate *in the countries*, which arise from their needs? Our latest is not necessarily their best. What kind of incentives can there be that will help us to develop the systems with them, that are appropriate, so that growth comes on both sides?

Dr. Baruch:

I think that you are asking an important question. I think Dr. Fusfeld stressed that the private sector has a role. I don't think that he ever intended to imply that the private sector has *the* role. I think what is important to me in my view of this whole activity is that industrialization is not a *state*, it is a *process*. There is an old saying, that if you give a man a fish, you feed him for a day; you teach a man to fish, and you feed him for his life. I don't think that the United States can play an effective role in bringing about industrialization in another country, but I think we can play an effective role in helping that country learn how to industrialize. And you can't start that except from the kind of group that is here. We need certain basic underpinnings.

When the private sector brings in materials, goods, machinery, it is geared to their most efficient use for getting a job done. That does not necessarily match the state of development of the country in which the art is being practiced. Many countries have negotiated agreements with private sector firms, to say, "Yes, you may come in and exploit our resources, but the price for that is not only money, but training, and the establishment of training programs to bring our people up to speed." I think if we stop thinking of industrialization as a developmental state rather than a developmental process, we will see that the main way we can help, both in government and in the private sector, is by teaching that process. And countries that have raw materials are in a good negotiating spot to

insist on that kind of help. But if the country insists instead, on the delivery of the shiniest new computers, or the fanciest new milling equipment, then that country itself doesn't understand what is going on. It is putting itself into a situation that can only be described as being a technological colony. And *that* I think most developing countries want to avoid.

Hamilton Herman (Industrial Consultant, Potomac, Maryland):

If you have a local, domestic Technical Applications Institute, in the developing country, it can become a technical translation mechanism. KIST in Korea is an example. The Institutes take the technology that happens to be current, say in the United States or in another developing country, translate it and put it in perspective to apply it to meet the particular state of progress, the particular state of industry, and the particular set of conditions found in their particular countries.

SECTION 2 - MEASUREMENT CAPABILITIES AND SERVICES REQUIRED BY TECHNOLOGICAL INDUSTRY

Chairman: Mr. Hamilton Herman, Industrial Consultant, Potomac, Maryland

CHAIRMAN'S COMMENTS:

The experience of the various people who are participating in this session can be most valuable. There isn't any one right answer. As Dr. Fusfeld suggested, there is an answer that happens to fit the particular country at a particular time, and therefore the range of applications of technology is a continuous spectrum depending upon where you happen to be in the time-phased development of your own particular country or, within a country, the time-phased status of an industry or a social problem.

Now the group this morning, this particular session, is going to address itself to measurement capabilities and services required by technological industry. Perhaps I'll go back just one minute to a few years ago when in this country they were telling jokes about "Good news, bad news". The story was about an airplane that you may have heard of whose pilot came on the intercom to the passengers and said, "Good morning. We have both good news and bad news for you. First, the bad news: we're lost. Now the good news: we're going 600 miles an hour." I think from a measurement and capability viewpoint, the idea is not to get lost. The idea is to chart out or put a grid under the technology and under the products and processes that you have, so indeed you do know where you are. And of course, the second point is, not only do you need to know where you are, but where you are going, and how to communicate with others, and of course these are the key points in the use of measurement capabilities and services, because if you don't have these, you neither know where you are nor do you have a sound base from which you can decide how far you've come and where you are going.

PAPER 2.1 - KOREAN MEASUREMENT CAPABILITIES: PAST AND PRESENT

Jong Wan Choi, Administrator
Industrial Advancement Administration
Ministry of Commerce and Industry
Seoul, Republic of Korea

1. SCIENCE AND TECHNOLOGY FOR INDUSTRIAL DEVELOPMENT

From the early days of man's history, men have constantly searched for better means and expanded their knowledge and experience in their given conditions to best satisfy their needs. As shown by modern economic history, we can easily observe that no country, even with abundant natural resources, capital and large population, can develop industrially without matching science and technology. More specifically, metrological capabilities in science and technology play a vital role, particularly in technological industry.

Under developing conditions, therefore, it is necessary to adopt the following two schemes, if scientific and technological development are to be obtained. Firstly, advanced science and technology should be vigorously imported. Secondly, domestic science and technological capabilities have to be built up in order to fully absorb, digest, and adapt imported technology to indigenous conditions and to develop domestic self-sustaining capabilities in science and technology.

In order for a system or a service to receive proper social appreciation and support for substantial development, it must be responsive to social requirements. The development of science and technology and a system for measurement cannot exist separately from industry, especially from industrialization. In short, a program to implement these systems must be carried out in accordance with the degree of industrial development or industrialization of the society. Of course, it is true that development of science and technology and, in particular, measurement capabilities, often plays a leading role as an accelerator in the process of industrialization.

It seems necessary to discuss briefly the status of Korean industry before getting into the details of the Korean system for measurement capabilities.

2. STRUCTURAL STATUS OF THE KOREAN ECONOMY

2.1 Rising Above the Rubble

Korea is a peninsula with 98,000 km^2 and 35 million population. Arable land is only 25,000 km^2 with few natural resources. The country was torn into north and south across the 38th parallel at the end of the second world war. The Korean War completely destroyed whatever industrial facilities existed at the time. The entire population had to come through hunger, poverty, and despair.

In 1962, the first government action for an economic development plan was initiated to break out of the vicious circle of poverty and hardship. Through a planned development of the economy, Korea achieved remarkable improvement in its national economy. In the course of this significant economic growth, the positive assistance in economic areas and science and technology which was provided by our friendly nations, especially the United States of America, has been of great help.

2.2 Progress of Industrial Development

Starting from meager industrial facilities with not a single large-scale plant in the 1950's, Korea started the march toward an epochal new stage of development in the 1960's. The first Five-Year Economic Development Plan in 1962 provided the foundation for industrialization toward a self-sustaining economy. The manufacturing industry grew steadily at the rate of 14.7% per year during the first Five-Year Plan period; at 21.4% in the second; and 18.8% in the third (see Table 1). Growth of the manufacturing industry led the way toward sustained growth of the economy through the three Five-Year Economic Development Plan periods, as can be seen in Table 1.

Table 1 - Annual growth rate of industry

	1962-66	1967-71	1972-76
Agriculture, Forestry and Fisheries	5.1	2.3	4.7
Manufacturing	14.7	21.4	18.8
Social Overhead Capital and Other Services	8.3	12.3	7.5

SOURCE: Courtesy of Economic Planning Board (EPB)

The strategies of industrialization in these periods can be summarized as follows:

a. The first Five-Year Plan period (1962-66) was characterized by a strong emphasis on consumer product industries and import substitution. Leading sectors were textiles, cement, fertilizers, and electric power.

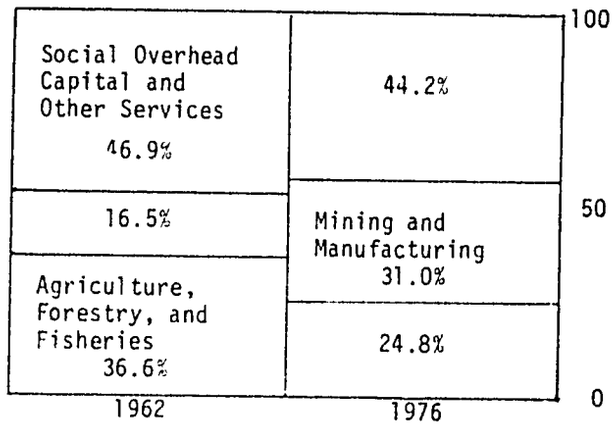
b. During the second Five-Year Plan period (1967-71), emphasis was shifted on the rapid growth of these industrial sectors and also to export-oriented industries. The period saw considerable increases in the export of consumer products and effective import substitution of consumer goods and intermediate products. Social overhead capital increased, and the new leading industrial sectors were synthetic fibers, petrochemical industries, and electrical equipment.

c. The basic targets in the third Five-Year Plan period (1972-76) were the export of intermediate and construction materials. Chemical and heavy machinery plants were constructed and went into operation. Iron and steel works, machineries, consumer products, and shipbuilding were the main industrial sectors that were especially fostered during this period.

The three Five-Year Plan periods stimulated development of the industrial structure toward a higher level. In 1976, mining and manufacturing were 31% of the entire industry; agriculture, forestry and fisheries, 24.8%; and social overhead capital and other services, 44.2%. The pattern has been shifted toward that of the advanced industrial structure (see Table 2).

Table 2

Composition of the industrial structure

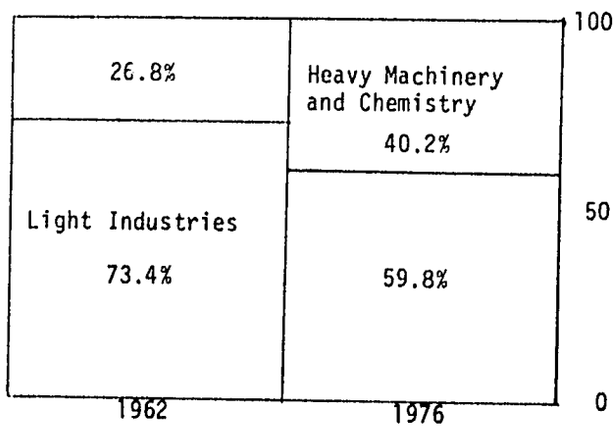


SOURCE: Economic Planning Board (EPB)

There has been a change in the industrial structure of the manufacturing sector also. The ratio of heavy and chemical industry versus light industry was 26.6% versus 73.4% in 1962, and changed to 40.2% vs. 59.8% in 1976 (see Table 3).

Table 3

Composition of the manufacturing industry



SOURCE: Economic Planning Board (EPB)

Export volume increased steadily during the periods of this industrial growth. The annual rate of export increase was 42.9% during the first Five-Year Plan period; 39.6% in the second; and 43.4% in the third. In particular, export of manufactured products increased at the rate of 76.2%, 48.7% and 44.6% during the same periods (see Table 4).

Table 4

Growth Rate of Exports

(In percentage)

	1962-66	1967-71	1972-76
Total Exports	42.9	39.6	43.4
Manufactured Products Exported	76.2	48.7	44.6

SOURCE: Ministry of Commerce and Industry (MCI) Data

Economists point out that the main factors in the remarkable industrial development of Korea are as follows:

a. Strong leadership and political stability.

b. Will and dedication of the people.

c. Abundance of skillful labor force with a high level of education.

d. Successful introduction of foreign investments for industrial development.

e. Success of export volume expansion.

Actual export volume reached $10 billion in 1977 and is expected to attain the goal of $12.5 billion this year. This export volume represents a 300-fold increase since the beginning of the Economic Development Plan in 1962.

3. HISTORY OF NATIONAL MEASUREMENT CAPABILITIES

Korea first established regulations governing weights and measures in 1902, although the national physical standards of the meter and the kilogram had been obtained in 1894. But it was only in 1959 that Korea ratified the Convention of the Meter and the Metric System. The System was put into force in 1961 to modernize weights and measures by enactment of the present "Law of Weights and Measures".

Under the "Law of Weights and Measures", those who manufacture or repair metrological instruments are required to obtain the government's license to ensure the precision and accuracy of such instruments. The license is presently issued by the Industrial Advancement Administration (IAA). In addition, metrological instruments fabricated, repaired or imported are subject to government inspection. All commercial metrological instruments are subject to mandatory inspection and calibration, while industrial instruments are, in general, left to voluntary inspection and calibration. Inspection and calibration services have already been established by various research institutes, testing laboratories, and industrial product inspection agencies, with reference to secondary level physical standards of weights and measures which are maintained by the National Industrial Research Institute of IAA and the Fine Instrument Center (FIC), which was established jointly by the Korean government and UNESCO.

As noted, industrial products manufactured during the First and Second Economic Development Plan periods (1962-71) were from the light industries and nondurable goods. This is why the weights and measures systems in Korea have initially focused on commercial uses to ensure equitable trading rather than on the industrial metrology sector for production processes.

In view of the government's policy in 1972, Korea has had to deal with building up its heavy and chemical industries. Korean industry, therefore, had to face new challenges in the technological industries. A timely survey report of NBS/AID in 1972 on

"Standardization and Measurement Services in Korea" accelerated the creation of a new national measurement system and body to meet the new phase of Korean industry. I would like to emphasize at this point that the survey projects by advanced countries play an immeasurable role in the creation of an infrastructure for industry in developing countries.

4. ESTABLISHMENT OF A NATIONAL STANDARDS BODY

4.1 Korea Standards Research Institute

In 1973, the Korean government established the Industrial Advancement Administration under the Ministry of Commerce and Industry. This idea was also recommended in a report prepared by NBS/AID in 1967. Since then, the Administration has worked for the creation of a national standards system (NSS). As one result, in 1975, the Korea Standards Research Institute (K-SRI) was established to be the central body of the NSS.

From its inception, K-SRI has received support in advanced measurement technology from the United States' National Bureau of Standards (NBS), a sister institute of K-SRI. Using a $5 million AID loan, about five hundred items, including prototypes of primary standards, were obtained in the first phase. Installation of 200 items is currently under progress, with a schedule of normal operation by April 1979. Future investments of $8 million from the Asian Development Bank (ADB) will provide supplementary standards equipment and facilities. With this equipment and facilities, K-SRI will be ready to support industry in various technical aspects.

The role of K-SRI can be summarized in the following three major activities:

a. Maintenance and dissemination of national standards.

b. Education of advanced measurement manpower.

c. Technical support for industrial firms.

d. General research work for weights and measures.

4.2 Establishment of the National Calibration System

In order to improve national measurement capabilities, a national standards institute alone cannot achieve the goal. A nationwide dissemination mechanism of standards through secondary calibration/inspection organizations is needed.
In Korea, no systematic and nationwide calibration/inspection network is available. Accordingly, a systematic calibration network, with K-SRI at the top in precision and accuracy is being planned, and the precision level of the entire industrial sector will be gradually elevated to the level of advanced countries (see Table 5).

5. NATIONAL CAMPAIGN FOR QUALITY CONTROL

So far we have laid the groundwork to modernize the measurement capabilities necessary to support technology-intensive industries, and much progress has been made in this area. However, this does not solve all the problems. It remains to be seen whether or not Korean industries are ready to utilize this measurement system.

A fact-finding survey of weights and measures was conducted in order to establish a basic policy for the service system. The survey revealed that:

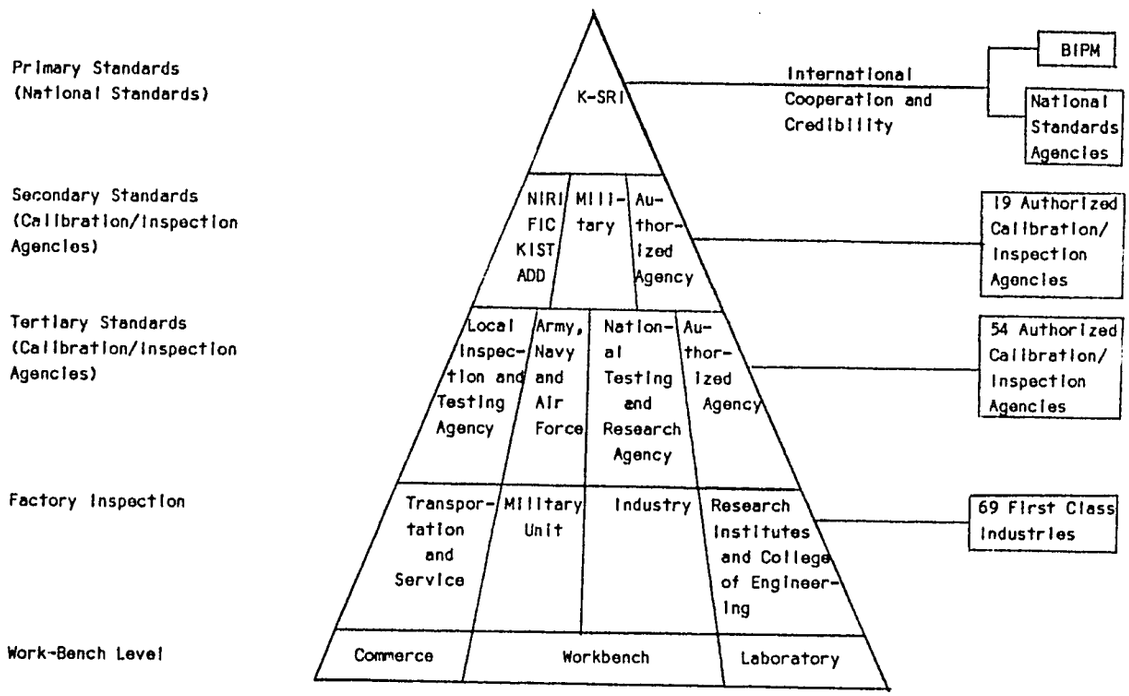
-First, industry has an insufficient number of precise and accurate measuring instruments, necessary in the manufacture of products meeting established standards.

-Second, the calibration of measuring instruments is not regularly done, in spite of the fact that it is necessary to maintain the precision and accuracy of measuring instruments.

-Third, management, especially top management, is lacking in understanding of the importance of weights and measures to industrial development.

-Fourth, there is an insufficient distribution of standard reference materials.

Table 5 - Nationwide calibration/inspection network



-Fifth, industry lacks an understanding of the need for standard reference materials.

To promote an awareness of the importance of the metrology and standards system and its full utilization by industries, IAA, in an effort to provide a broad base in this area, launched in 1975 a nationwide quality control campaign throughout the country. This massive campaign started with a publicity campaign wherein about 1 million pieces of educational material related to the importance of quality control were distributed. The publicity campaign was followed by many educational programs. As shown in Table 6, from top to middle management down to technicians and workers in the working line level, more than 36,000 persons completed the educational programs.

Next, to introduce the quality control system to manufacturers' production processes, the government designated 2,500 firms as leading quality control companies to implement and develop quality control methods in the hope that these companies' experiences will be shared by medium and small industries.

Table 6

Status of Quality Control Training

	1975	1976	1977	Sept. 1978	Grand Total
Top Managers	885	255	356	773	
Quality Control Personnel	395	701	742	552	
Middle Managers		327	543	1,005	
Group Leaders	1,635	1,376	2,899	3,363	
Others	4,817	6,356	6,196	3,628	
Total	7,732	9,016	10,736	9,321	36,805

For quality control at the work bench level, 29,000 quality control circles composed of workers at the actual work lines have been organized and are now operating. We have conducted about 500 seminars, workshops, and public campaign meetings on quality control topics throughout the industrial sector.

We also organized annual National Quality Control Promotion Conferences to assess past achievements and to promote further developments in quality control. At tnese conferences, we have a national prize-awarding ceremony to honor outstanding firms and individuals in their quality control achievements. This campaign has proved successful in establishing awareness of the importance of quality control. Consequently, this effort has induced utilization of the national measurement and standards system.

6. CONCLUSION

We have built the groundwork for the national measurement and standards systems for Korean industries, which face new challenges in advancing toward a higher level of technological capability. We have encountered many challenges and obstacles which we have been able to overcome with wisdom, innovation, and hard work.

We face more challenges and obstacles in the road ahead for further industrial growth. But we now have the confidence and aspiration from the wisdom and lessons of past experience. As President Park pointed out, "We have now overcome the yokes of fear and despair of the past, and found the courage and confidence to achieve the goals we set out to achieve."

We welcome cooperation with friendly advanced countries on a continuing basis. We will do our best to share our own experience and will seek the cooperation of small and economically developing countries.

In the meantime, Korean measurement capabilities will march on forward.

Thank you.

DISCUSSION:

Mr. Hamilton Herman (Industrial Consultant, Potomac, Maryland):

It is tremendously obvious from what you said, that Korea in the short time of 16 years, which even in industry is not a lot of time, has made tremendous progress with its technology and industry and the development of the nation; because it has political stability, a national purpose, and a plan for development which changed as it progressed. Korea had the right kind of leadership, it was able to get its educational system going and to develop a skilled labor. It had help from foreign investments, and in developing exports it brought in income which helped to continue the process of development. It had assistance from outside the country through U.S. AID and NBS and others, which helped them to get the development plan rolling.

The original target for standards was to provide a method of communication with other nations, especially in international trade. As Korea progressed and developed heavier industry, it became necessary to apply these standards to production methods within the country. In spite of its impressive progress, Korea has launched an aggressive program to come up with an even stronger capability for measurements, standards and quality control. Korea is still moving, still progressing. That is an extremely interesting and progressive history of a successful development effort.

Mr. Jacob Blackburn (Director, Office of Technology Policy and Space Affairs, U.S. Department of State):

Could you name one element that was probably the most important single element in your rapid industrialization?

Dr. Choi:

Political stability and dedication of the people, the *will* of the people. Hard work.

Robert S. Walleigh (Senior Adviser for International Affairs, NBS):

I just returned from ten days in Korea, and I can attest to the fact that the people there work very hard. If they have any welfare in Korea, I didn't see any evidence of it. I think that your work week is six days, and I think you have a ten hour day for the workers - it's a long day, anyway - and I think that the school children are also motivated in the same way; they, too, have a long work day. I think that much of what has happened in Korea can be attributed directly to the ethic of the Korean people themselves.

J. E. Owino-Okwero (Kenya Bureau of Standards, Nairobi, Kenya):

How do you get the people to work hard?

Dr. Choi:

The Korean people work hard because they have a sense of belonging, a sense of achievement, united they achieve their goals, a national purpose.

Dr. David S. Lieberman (University of Illinois):

Is the system there the same as Japan, in that they do not have antitrust laws, so that the government can encourage companies working together, etc.?

Dr. Choi:

I think that we have more or less the same kind of system that the Japanese have.

Joseph M. Lightman (U.S. Department of Commerce):

Did you say that Korea has adopted the metric system? How does this apply to exports of United States products?

Dr. Choi:

Yes. For exports, our manufacturers are producing according to the buyers' specifications. It is a little bit complicated. Sometimes they have to use the metric system, sometimes another country's system. For internal uses, we enforce the metric system.

Andrew A. Canellas (Small Business Administration, U.S. Department of Commerce):

Considering the enormous increase in exports that your country accomplished during that sixteen year period, would you care to make any comments concerning the role of the development of small industry in Korea?

Dr. Choi:

I think that small and medium industry contributed greatly to our export business. About 40% of our total export volume is from medium and small industry.

PAPER 2.2 - ON THE NATIONAL STANDARDS SYSTEM IN KOREA

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National Industrial Research Institute
Industrial Advancement Administration
Seoul, Korea

1. DEVELOPMENT OF NATIONAL STANDARDS SYSTEM

The National Standards System in Korea has a long history, but the fundamentals of the current system were conceived in the early 1960's. As the Republic of Korea Government formulated the First Five Year Development Plan (1962-1966), it began to concern itself with improvement of the quality of industrial products and productivity in order to achieve the goals of that plan: industrial development, replacement of imports with local products, export expansion, diversification of the industrial structure, and protection of consumers.

In 1961, the government enacted the Industrial Standardization Law to improve the quality of industrial products, promote interchangeability of manufactured products, and increase industrial efficiency. The Bureau of Industrial Standards was organized, with responsibility for the establishment of Korean Industrial Standards. In addition, a KS-mark system was initiated to encourage quality control.
Also in 1961, the Republic of Korea Government enacted the Weights and Measures Law to establish and disseminate metrology standards and support quality control and industrial standardization efforts. Consequently, the Bureau of Weights and Measures within the Ministry of Commerce and Industry was made responsible for matters relating to weights and measures.

In 1967, the government passed the Industrial Product Quality Control Law to improve the quality of industrial products and protect consumers. Under the Law, quality inspection and quality marking were made mandatory for certain classes of products.

In 1973, the government established the Industrial Advancement Administration (IAA), subordinate to the Ministry of Commerce and Industry, to more effectively supervise programs concerned with the quality control of industrial products, industrial standardization, inspection of export goods, and protection of consumers. Concurrently, the National Industrial Research Institute was reorganized with responsibilities for the quality control, testing, and inspection of industrial products.

In 1975, the Korea Standards Research Institute was established as an autonomous organization to maintain national metrology standards traceable to international standards and promote improved measurement capabilities throughout Korea. The responsibility for matters relating to national standards under the Weights and Measures Law was delegated to that organization by the Industrial Advancement Administration.

The following diagram shows the pattern of the present National Standards System in Korea.

2. TECHNICAL AND FEASIBILITY STUDIES DONE PRIOR TO THE ESTABLISHMENT OF PRESENT NATIONAL STANDARDS SYSTEM (NSS) IN KOREA

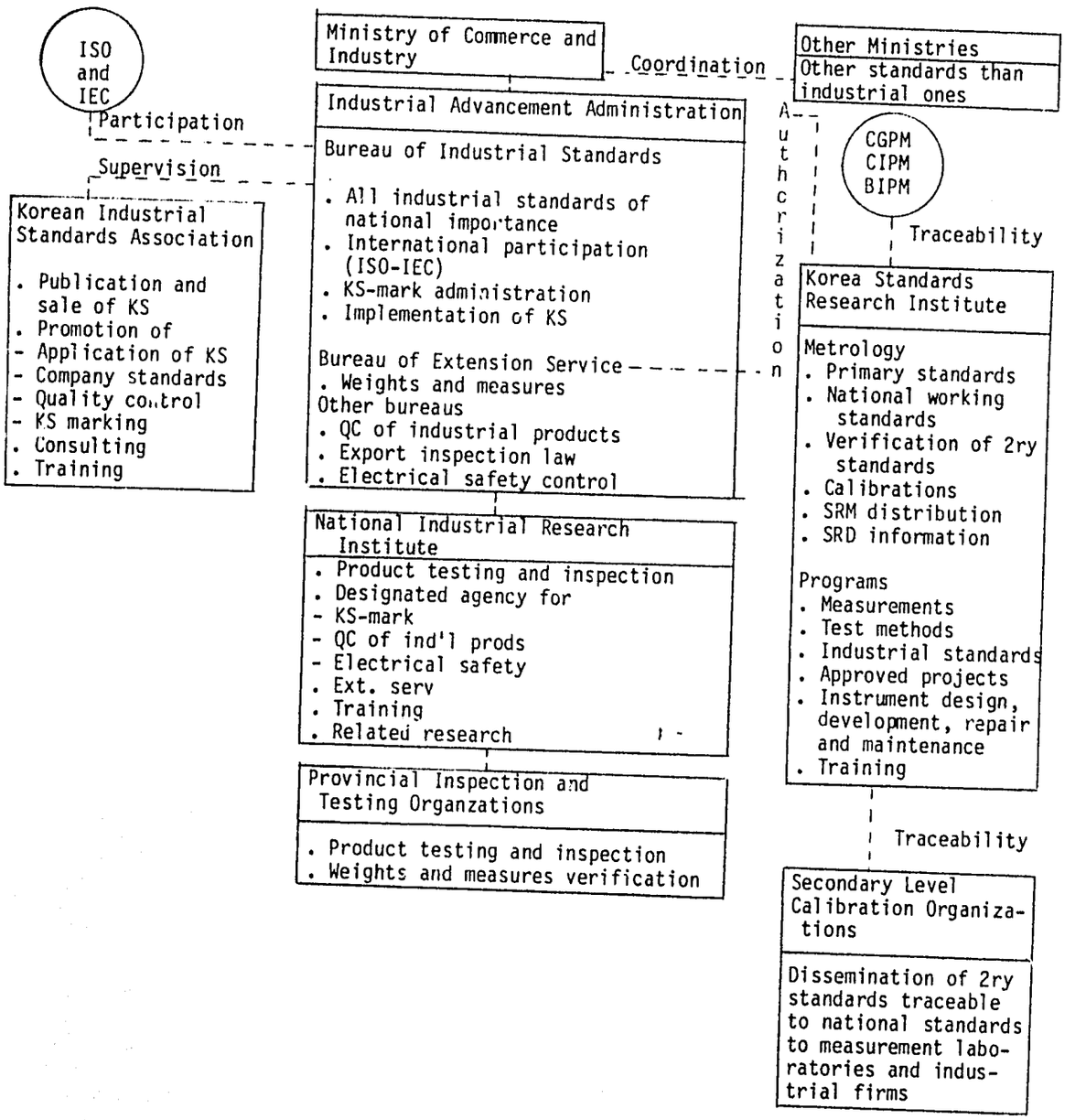
2.1 1967: U.S. National Bureau of Standards (NBS) Team Survey

An AID-financed NBS survey team, headed by Dr. Forest Harris and including Mr. Steffen Peiser and Dr. Ronald Eby, recommended the strengthening of the NSS, with prime responsibility for industrial standards, metrology standards, and quality control to be combined in one government agency. At the time, however, other Korean development needs appeared more urgent, and no action was taken on the recommendations.

2.2 1972: NBS Team Survey

A second NBS survey was conducted in 1972, with AID-funding. Members of the team included Dr. Thomas D. Coyle, Dr. Eby and Mr. Peiser.

National Industrial Standards System



The NBS team made recommendations for improvement of numerous areas, among them that the NSS strengthen its efforts in metrology standards. In accordance with other recommendations of the survey, the nation established the IAA, and reorganized the National Industrial Research Institute.

2.3 1973: IAA Survey, Report for Establishment of a National Standards and Testing System

The IAA survey had two basic purposes: (1) to determine the extent and nature of calibration activity for measurement devices in government agencies and industrial firms and (2) to determine the domestic demand for SRM's. Although the response to questionnaires was disappointing, the IAA was able to conclude that there was limited understanding of the value of calibration, that few firms actually prepared calibration schedules or had their instruments calibrated, and that few of the standards and measurement instruments in use were Korean-made. There was also limited understanding and use of SRM's. This survey reinforced the IAA's conviction of the need to establish a strong national metrology standards system.

2.4 1974-1975: GE-TEMPO Feasibility Study

The purpose of this study, financed by AID under the Second Feasibility Study Loan (489-H-083), was to survey the existing national standards system and recommend the creation of new organizations and/or suitable restructuring of existing ones to produce a national standards system fully adequate to support current and future economic development plans.

As a result of its studies, the GE-TEMPO Team made two principal recommendations:

(1) That the IAA assume a more aggressive technical role through closer supervision and control to ensure the effective functioning of the national standards system.

(2) That a Korea Standards Research Institute (K-SRI) be established as an autonomous organization to maintain national metrology standards and promote improved measurement capabilities throughout Korea.

Based on those recommendations, the Korean Government has reorganized the existing national standards system into the present one to strengthen and spread industrial standards, quality control, quality assurance of industrial products, and capabilities for accurate measurement.

3. STATUS OF KOREAN INDUSTRIAL STANDARDS

Korean Industrial Standards are classified into 13 categories based on technical fields. The number of the standards as of the end of June 1978, was 5,684.

3.1 Procedures for Establishing Korean Industrial Standards

(1) The standards are drafted by government agencies, manufacturers, or consumers and submitted to the Bureau of Standards, Industrial Advancement Administration (IAA).

(2) The Bureau of Standards studies the draft, comparing it to existing domestic and international standards.

(3) The draft and relevant information are reviewed by a Divisional Committee of the Council for Industrial Standardization.

(4) If necessary, the Divisional Committee organizes a Technical Committee to study the draft.

(5) The Bureau of Standards reviews the final draft submitted by the Council for Industrial Standardization and announces the new standard.

(6) Once established, industrial standards are effective for three years, unless the Bureau of Standards finds them obsolete. Every three years, each standard is reviewed by the Council for Industrial Standardization.

3.2 Korean Standards Marking System (KS-mark)

Under the KS marking system, the Bureau of Standards of the IAA designates products that will be eligible for KS-marks and invites manufacturers to apply for authorization to use the KS-mark. Personnel from the IAA then inspect the applicant's plant to assess

management, plant standards, quality control procedures, measurement and testing capabilities, and the product's compliance with the pertinent Korean Industrial Standard. If the IAA makes a favorable assessment, the manufacturer is authorized to affix the KS-mark on his products. Periodic inspections of the product and plant conditions are made to insure that the manufacturer maintains satisfactory performance; otherwise, his privilege is withdrawn.

Products bearing KS-marks have several advantages; they are given priority in procurement by governmental agencies, and they are exempted from quality inspections required under the Industrial Quality Control Law and export inspections required under the Export Goods Inspection Law. Despite these advantages, only 437 firms have obtained permission to use KS-marks to date. The IAA is considering several measures to increase industrial participation in the program, including the following:

- increasing the number of eligible products;
- making KS-marks mandatory for certain classes of products, e.g., those required by the defense sector and those involving potential consumer hazards; and
- adding stronger incentives such as granting KS-mark firms preferential treatment in the allocation of foreign exchange for imports.

In addition, the IAA plans to strengthen the program by more frequent inspection to verify that KS-mark products actually conform to standards.

4. NATIONAL METROLOGY STANDARDS SYSTEM

The national metrology standards system in Korea, with the Korea Standards Research Institute in particular at the head of that system, is insuring measurement reliability by carrying out the following primary functions:

- disseminating these standards in useable form to measurement laboratories and industrial firms;
- maintaining these standards and instrument accuracy through supervision of a national calibration service, inspection activities, and control over the measurement instrument industry, and
- refining and upgrading national standards through research, development, and advisory activities.

With the utilization of Korean national standards traceable to internationally recognized standards with periodic calibration to maintain that traceability, the newly established metrology system is expected to make a great contribution to a high percentage of accurate measurements, decreased reliance by Korean laboratories and firms on foreign facilities for the supply of standards and calibration services, and an increasing number of measurement standards developed or modified to satisfy Korean needs.

DISCUSSION:

Mr. Joel Bernstein (U.S. National Academy of Sciences):

With respect to Mr. Kim's estimate of the actual impact of standards on quality control work on Korean industry, I gathered from your comments that the survey in 1974 suggested that standards still were not being effectively applied in a large part of Korean industry. For about nine years up to that point Korean exports had been expanding at about 40% a year. This raises some question as to whether standards and quality control are as important as we all tend to believe they are for the expansion of exports, or whether there is some substitute mechanism operating to deal with quality control problems.

Mr. Kim:

As to quality control in 1974, there was quality consciousness in the enterprises and the factories. At that time, understanding of metrology was less well understood than industrial quality control. In 1980, it is our goal to have industrial quality control and metrology standards together, working together.

Mr. Bernstein:

You are saying that you had effective quality control without a good metrology system?

Mr. Kim:

At that time, there was less understanding of the metrology standards than the industrial quality system. However, without the metrology standards, we cannot attain the quality control level we want. Nowadays, as a result of our campaigns, there is more understanding of the importance of metrology standards.

Dr. Stephens (Georgia Institute of Technology):

There are many levels of quality control that are practiced in a country. Certainly one of the first levels of quality control is at the in-factory company level. It is entirely possible for various enterprises to be carrying out programs and systems of effective quality control in their own individual companies long before the nation as a whole gets its total infrastructure and development prepared to spread that movement to the country at large. I think probably what was occurring in Korea during this nine year period that you were mentioning is that individual companies, with even the multinational transfer of quality technology into those companies through their home offices, were building up the quality system of individual goods that were prepared for export during that period.

Mr. Bernstein:

Most of those companies were Korean companies.

Dr. Stephens:

But many had overseas trading partners and/or were joint ventures or had licensing arrangements, where through those joint ventures and license arrangements there would be a transfer of quality technology.

Mr. Bernstein:

Was the Korean export board able to establish effective quality control without the metrology system?

Mr. Kim:

No, we cannot do it without the metrology system, so we are now building such a system.

PAPER 2.3 - EXPERIENCE OF A MAJOR U.S. FIRM IN A NEWLY INDUSTRIALIZING COUNTRY

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General Electric de Mexico
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The General Electric Company, which yesterday celebrated its Centennial, established in 1896 in Mexico the Mexican General Electric Co. -- which started its activities with 23 people -- as a sales outlet for GE products imported from the United States. In 1930 the Company initiated in Mexico the manufacture of incandescent lamps in the City of Monterrey, 600 miles north of Mexico City. The manufacturing of home appliances was started in Mexico City in 1948.

The Company in Mexico is organized by Departments, which are the profit-and-loss centers, and Operations, which are basically the supporting functions. The current product scope of General Electric of Mexico includes flat irons, toasters, blenders, fans, water coolers, evaporative air coolers, washing machines (both the wringer type which is practically obsolete here in the United States and the automatic style), refrigerators in several models, radios, TV receivers (both monochrome and color), and stereophonic consoles in the Consumer Products Department. The Industrial Products Department manufactures motors from subfractional, hermetic, fractional, to integral; also distribution and power transformers are manufactured in that Department, and switchgear and control boards. FM Mobile Radio equipment is made also in Mexico. In the Lamp Department, located as I mentioned earlier in the City of Monterrey, incandescent lamps from the standard domestic type to the miniature and special types like infrareds are manufactured. Also, fluorescent, multivapor, and high intensity discharge lamps are made.

The sales for the Company in Mexico amounted to 2,400 million pesos in 1977, which is equivalent to 104 million dollars, and the overall sales figure for the General Electric Co. worldwide was 17.5 billion dollars. The number of employees in the Company in Mexico is around 5,000 people, out of which 900 work in the Lamp Department. General Electric Co. has also about 2,000 Mexican employees in the Border Zone "in bond" Plants.

The manufacture of lamps is a process that has been highly mechanized since the very beginning of the production of the electric lamp. There is a high degree of local integration, by that meaning that most of the components of the lamps are manufactured in our Plant or at least in our country. Of course, some of the most critical materials have to be imported and will be so probably a long, long time in the future.

The main ingredients in lamps are glass and tungsten. The glass is manufactured in the Plant, starting from silica sand that has to be imported because of the chemical composition and short supply of the sands available in Mexico, which are often contaminated with some metals, mainly iron, which do not render good glass. Mainly two kinds of glass are manufactured in our Plant in Mexico; one is known as lead glass, and the other is soda glass. The soda glass is used for the bulbs and external tubes for the fluorescent lamps. The lead glass is used in the manufacture of so-called mounts, which are the parts on which the filament, the support wires, and the lead wires are mounted, and this is really the working heart of the lamp, which is then sealed into a glass bulb or tube depending on the kind of lamp.

The glass ovens were built in the Plant in Mexico following designs made by General Electric in the United States in its specialized glass plants. American engineers and technicians were sent to Mexico a long time ago, in order to supervise the construction of these ovens and the starting of operation of the glass making process. In the process of glass manufacture, as well as in the remaining processes for lamp making, the basic designs, engineering, and systems come from the highly specialized parent company departments in the U.S.

There are certain very critical measurements that have to be made with some of the

components, let's say glass: [illegible] important properties of the lead glasses are their coefficients of expansion, which are very critical since they will determine the life of the lamp, to an extent, and the yield in its production. There are three basic methods to measure the coefficient of expansion of the glass, out of which two are available in the Mexican Plant, both of which involve the comparison of coefficients of expansion of the sample glass produced by us, versus those of a standard glass provided to us by the GE Glass Laboratory in Ohio.

The laboratory that we have in Monterrey takes a sample of the glass being produced in our furnaces, and a small piece of it is bonded to a similar piece of the standard glass of known coefficient of expansion. When both pieces are bonded together and annealed, these are cut crosswise and polished to a very high degree. Then under a polarizing microscope, the kind and magnitude of the stresses at the boundary are determined. By means of this data as input, a calculation can be made in order to determine the coefficient of expansion of the unknown sample.

There is another procedure which is just a rough approximation, which consists basically in doing the same thing, that is, bonding together two pieces of glass, one of known properties and the other under test. The two pieces together are heated and pulled in order to produce a long fiber, which is really a dual fiber of the two kinds of glass bonded together. If there is any difference in coefficient of expansion, in cooling down, one of the two fibers will have a greater pull than the other thus bending or flexing more or less the composite fiber in one direction or the other, and by measuring the angle of deflection an approximate idea of the differences of coefficient of expansion can be obtained. In addition, there is the procedure of using a dilatometer.

In any event, regularly samples of the same glass that is tested in our laboratory are sent to the glass laboratory that belongs to GE in the United States, where much more accurate and extensive tests are performed, and this provides us with a basis for a final correction or control of our glass making process; that is, to correct the formulation of the loading of the furnaces, in order to change the chemical composition of the glass to modify accordingly the physical properties of the same. In order to double check our own findings for other tests, samples of the same batches are sent on a regular basis to the Glass Laboratories up in Cleveland and/or to other local materials testing laboratories; this is particularly true of such raw materials as the silica sand.

There are many other tests with the glass products that are performed in our factory in Monterrey, following technical data regarding characteristics and procedures furnished to us by General Electric Co. in the U.S.; the same is true of highly specialized equipment such as one piece of equipment known as the polyscope, which is an optical inspection device designed and built by Glass Technology Laboratory of the Lamp Glass Department. It provides a flexible system for examination and/or measurement of glass parts and the stresses within them.

As to the lamps proper, they are manufactured in highly mechanized equipment also designed and built by one of the components of the General Electric Co., since this is a highly specialized kind of equipment requiring sometimes on the order of three years for delivery. In these machines known generically as "groups", first the "mount" is made; such a mount is nothing else but the working assembly of the lamps, i.e., the lead glass portion on which the supporting wires for the filament are inserted and also, which is more critical, into which the lead wires are introduced.

The lead wires are very critical for the following reason: in the portion in which they pass through the glass, a perfect seal has to be accomplished, therefore in this portion a special material, known as Dumet, is used. This material is produced in the Refractory Metals Products Department of the General Electric Co., again in Cleveland or nearby, and sold to us in the required dimensions. Without boring you with the details, I'll simply say that the most important property of this material is that it has practically the same coefficient of

expansion as the lead glass to which it is sealed, thus avoiding as much as possible any relative movement between glass and metal in order to avoid micro-cracks that could develop into leaks which would shorten considerably the life of the lamp.

The dimensional characteristics of the lamps are verified by means of optical comparators, the polyscope itself and other kinds of calipers, more or less of the standard type. But some of the more critical or peculiar characteristics of the lamps, such as luminous output and efficiency, and lamp life, which are the ultimate parameters of interest to the user, as well as some other physical characteristics which have a definite influence on these last two parameters (such as pressure of the inert gas filling the bulb itself) -- all of them are measured with equipment which to some extent is more or less standard in the field and in some instances is designed and built also by the General Electric Co. in the U.S. Among the first, we have the integrator type of photometers, which are calibrated by means of standard lamps furnished for every specific type of lamp and recalibrated periodically by the Lighting Laboratories in N la Park.

The performance and safety standards to which these products must conform are basically of three kinds, specifically:

1. Official standards written by the Government -- Dirección General de Normas -- which is an organization that draws on the technical assistance of private enterprise and the universities in order to arrive at the most adequate standards of performance and safety in the country.

2. In case of exports, tne local applicable standards.

3. The GE Co. standards of performance which in some instances are even more stringent than some official standards.

I can very proudly say that we managed to increase the quality level of our products to the extent that they could be exported to Germany, France, and, above all to the Unit States of America, complying with the very, very stringent standards of quality of General Electric Co. for this product in this country.

How did we accomplish this? Just by following a set of routine procedures? Well, unfortunately, that is not enough. The following of some routine measurements and procedures sometimes tends to degenerate or to be slackened through the years, because sometimes it is much easier to manufacture with components slightly different in dimensions or by slackening some of the specifications, but always more or less within the current standards of acceptance. In my considered opinion, the most important factor in accomplishing a truly competitive quality, is instilling in the working personnel quality consciousness and, obviously, the awareness of the need for accurate measurement of properties to detect promptly any deviation that could occur from the pre-set minimum standards of quality for any of the parameters.

Of course, there is the need for a technological base of knowledge for the technical people responsible for all these measurements or preservation or even establishing of parameters. This is relatively easily accomplished through adequate training programs for qualified technicians throughout the rank and file of the organization, training which is accomplished either by taking advantage of the facilities of our parent Company in the United States, or by sending specialists or experts to conduct training seminars on specific subjects in our premises, or by designing and implementing our own training and motivating programs, or by a combination of the mentioned alternatives. So in the case of lamps as well as for the overall Company, a training and development plan for both managers and technical or other employees was established.

From long experience we have come to recognize that an essential ingredient in the training and development of personnel is the climate of an organization, the cluster of concepts, attitudes, and patterns of behavior that make up the organizational environment within which people develop their potential as managers or high caliber technicians. The first step in the development of this

program, and one that has proved to be of prime importance, was creating the right climate. What that is and how it is created, is in many ways difficult to communicate, especially to seasoned employees who have been accustomed to think in concrete and measureable terms -- units of production, sales dollars, profit percentages, quality standards and the like. This climate has to be, first, one in which managers accept the paramount importance of people, co-equal with technology and financial resources, as a prime ingredient in organizational accomplishment. Secondly, it has to be a climate that focuses the attention of managers on performance, if they are going to maximize the contribution of their subordinates and their development. A climate that generates this emphasis on people and their performance is one in which all managers acknowledge that training and development is the logical and tactical way to enhance both individual and organizational progress.

So, one of the first steps that were taken to establish this kind of climate and to support the effectiveness of a proper training and development plan, was to adapt the Quality Control Circle concept developed in the 50s in Japan, by conducting a series of courses on elementary statistics and quality control techniques for machine operators and supervisors, not to mention higher level courses on essentially the same subjects for some of the managers and engineers in the Plant. The courses for the higher level were developed with the assistance of the leading local University in the City of Monterrey, that is Monterrey Tech., and were, of course, a lengthy program; and for the supervisors and machine operators, these programs were conducted on an adequately accessible basis. The information we obtained at the time on Quality Control Circles was derived mainly from papers in trade magazines such as *Production Engineering*, *Quality Control*, and the like. Stated briefly, a Quality Control Circle is a small group, no more than six people, who meet together regularly to analyze and offer suggestions to solve quality problems.

According to J. M. Juran, the Japanese have rejected the Western theory that quality problems are due to worker indifference, blunder, and sabotage. In the January 1967 issue of *Industrial Quality Control*, he writes:

"The Q.C. Circle starts with a different set of beliefs:

"(1) We really don't know the cause of our quality troubles; we don't even know which are the main troubles.

"(2) Hence, we must teach people how to analyze the trouble pattern in order to identify the main troubles.

"(3) We must teach people how to list the suspected causes of the main troubles and how to discover which are the real causes.

"(4) We must help people to secure remedies for these real causes.

"(5) Finally, we must teach people how to sustain these gains through modern control methods."

One of the most refreshing experiences in this kind of program is the eagerness to learn that is present in practically all of the Mexican employees and workers. The instant we announced an opened course, it was full to its capacity, and in many occasions there has been the need to organize additional courses to take care of the applications.

The training and development programs did acquire such an importance that through the recent years the number of man hours in courses was increasing until it reached a peak of more than 140,000 in 1975, after which year a decline began to show due to mainly two factors: on one hand, by that time practically all of our managerial and supervisory and professional population had been exposed to the basic programs and even some of the intermediate ones on management and motivation, therefore, the need to conduct very extensive courses decreased; and the other factor has been, of course, the devaluation and economic crisis that our

country experienced starting in September 1976.

To conclude this description, I would like to say that in my personal opinion, the three principal factors key to the success of the establishment and operation of a technological industry in our country, are:

1) The technological support from a very qualified -- scientifically and technologically speaking -- multi-national company.

2) The absolute conviction that the most important resource in any given enterprise is the Human Resource.

3) The adequate approach to the training and development of that Human Resource, with the proper motivation.

This is in line with what Professor Gunnar Myrdal wrote in the September 1974 issue of *Scientific American*:

"For effective technology transfer it would be better to send teachers to the universities and schools in the underdeveloped countries. Some of them would at least get to understand what the practical problems there really are. Those who come to the developed countries for training should not be students, least of all undergraduate students, but people who are already established at home, for example physicians who want to learn a particular new technique or engineers who are out to master a new industrial process."

DISCUSSION:

Mr. Hamilton Herman:

Here you have a major, sophisticated, United States company setting up quite some time back an expanding range of product manufacturing in Mexico. In effect, they took down there the know-how, the standards, their patents, and their people to get the businesses started. They trained the people down there to run the business. We will all recognize this as a pattern that has occurred, whether it is U.S. companies, or Italian, or French, or German, in many countries. To a degree, that pattern has been rejected in some countries where they have wanted to nationalize these companies, apparently under the feeling that they really didn't have a good partnership going. It is particularly important to note that General Electric placed great emphasis on the Human Factor, and as Mr. Coria said, at the very end, they had support from the parent company, but then they got busy, and they made sure that the people there understood the business, participated in the business, and had the purpose, that Dr. Choi referred to in his talk. In this case, the purpose apparently was as much generated by the company as by the Government.

What was the relationship in standards and quality control between the Company and the Country?

Mr. Coria:

There is a standards writing organization in my country. Fortunately, this organization resorts to private enterprise and to the universities -- the National Polytechnic Institute, the Autonomous University of Mexico -- for the preparation of these standards. And the General Electric Company of Mexico, as are many other technological industries in my country, is very active, participating in the different committees for preparation of these standards. Also, the local government Ministry is very conscious of quality, and so they propose standards, with particular relation to health and safety. Inspectors come to our plants from time to time, and check that the instruments are properly calibrated. They take random samples of particular products to check for performance. This is a regular procedure, and has been so for many years.

Dr. David Goldman (Acting Associate Director for Long-Range Planning, National Measurement Laboratory, NBS):

A couple of years ago I spent some time in Mexico City and I toured the laboratories of the National Telecommunications Organization. I was very impressed with the state of technology development practiced by

that Organization. It surprised me that they trace their time and frequency standards back to NBS-WWV in Boulder, Colorado. My question is, what interaction does the sophisticated company in the field of telecommunications have vis-a-vis the National Telecommunications Organization within the country?

Mr. Coria:

Our relationship is that in order to be able to offer to the public market our products, we have to comply absolutely with all the specifications established by this Organization. So, we have to submit to them, not only samples of the products we manufacture for testing in their very complete laboratories, but also provide documents known as "memorials", which are technical descriptions of the performance, and we make a commitment of the standards that we promise to meet. So, every product has to be tested and approved by a governmental agency, in this particular case by the Telecommunications agency, in other cases by another agency.

Dr. Goldman:

Do you find that that inhibits your development? Does that fact that everything that you do is type-tested in a governmental laboratory, does that prevent you from doing things that you might like to do?

Mr. Coria:

I don't really think so. Since this has been a standard procedure for years, we know in advance -- we had better know in advance -- that we will be subject to all of these regulations. This works to the advantage of the most serious industry, and it affords our country access to the markets of the United States, so I would say that it is good for us.

Mr. Robert S. Walleigh (NBS):

Are all of the employees of GE in Mexico now Mexican, or are there still U.S. advisers?

Mr. Coria:

There are still some American employees, but the number has decreased very substantially. We have now most of the employees in key positions being local nationals.

Mr. Joseph Lightman (Commerce Department):

We understand that in Mexico in order for an American company to license or transfer technology to a Mexican firm, that agreement has to be submitted to a registration procedure and approved by the government in order for it to be enforced and payment to be made. Also, you have to accompany your normal trademark with an equivalent Mexican version. Has this adversely affected your operations down there? Has there been any limitation or control or restriction with respect to technology coming from GE headquarters in Schenectady?

Mr. Coria:

In our particular case the trademark requirement has not very adversely affected us, because our local trademark has been very, very popular in our country for many years. And as a matter of fact, requirement of the dual trademark helps us, because if you don't have that proper dual trademark, it could be that you have smuggled the appliance in from the United States. I don't think that restrictions on technology flow have been really a very severe restriction, but there are some limitations, particularly on the amount of money that the GE Company in Mexico can pay to the Company in the United States, and this is under control of the National Council for Science and Technology. We keep records and logs of all the technological transfers, transactions, with the Company in the United States, which are at the disposition of visiting scientists of that Council.

Dr. Khaled Y. Al-Khalaf (Saudi Arabia):

Was it a 100% U.S. firm in 1930, or was it a joint venture with some Mexican nationals?

Mr. Coria:

This company was for many years a 100% U.S.-owned company. It was not until some ten years ago that part of the company was Mexicanized, just a small part of it. Under the current law, in order to establish a new foreign company in the country, there is a need for at least a ratio of 51% of the stock owned by Mexicans, 49% by foreigners. But that is not the case for General Electric.

Mr. Ridha Bouhalila (Tunisia):

What standards do you use when you export to the Common Market countries?

Mr. Coria:

In the case of our exports to France and Germany, we were meeting the specifications of our specific customers: in the case of Germany, that was Volkswagen; in the case of France (speaking of lamps), that was the Renault company. So I think, those were the International Standards Organization specifications.

Dr. Lee Kum Tatt (Singapore):

How much do you have in the way of supporting industries? Is the operation mainly assembly? How much do you make locally?

Mr. Coria:

We happen to be very highly vertically integrated. For instance, in the case of flat irons, probably the only thing we buy are some screws and packing materials. So, we are very, very heavily vertically integrated, in our plants and also in our country. In many of our products we have about 98% of local integration, to help the development of local industry and because of governmental restrictions. It applies in electronics, too. Absolutely. Particularly in entertainment consumer electronics. But not that much in the communications field, which requires more sophisticated or more precise components.

PAPER 2.4 - ELECTRONICS METROLOGY IN ARGENTINA

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1. METROLOGY AND ELECTRONICS DEVELOPMENT

New and better products have been manufactured with the advance of technology. During the manufacturing process and after finishing the products we now require a more accurate and precise metrological control to assure meeting the specifications.

Electronics is one of the techniques which has developed more in recent years for two basic reasons -- the space programs and military hardware and techniques. In addition, electronics has great influence over other techniques like medical technology, air navigation, communications, and others. Our country has followed all the process, however, naturally not in the same degree as highly developed countries did.

2. METROLOGY IN ARGENTINA

Until 1940, metrology in our country contributed mainly to the field of agricultural and cattle products. After the Second World War development began in Argentina of several types of heavy industries, in particular the automobile industry. The need for interchangeability of parts promoted applied metrology to assure nominal values with certain tolerances. A reference basis in metrology became necessary, and in 1957 INTI was created. So our effort in this field began 20 years ago.

As industry grew and diversified, the Physics Department of INTI divided into six groups, dedicated to mechanical, electrical, electronical, thermal, acoustical, and optical measurements. To get experience, INTI contacted other Institutes like PTB (West Germany), NBS (USA), NPL (England), LICE (France), looking forward to establishing technical agreements with that purpose. Between 1968 and 1972 PTB hosted technicians and professionals from INTI during one year periods and delivered high quality metrology equipment.

At the same time in 1972 a body of law was promulgated for metrological regulations, as a result of the country's interest in its growing industry. The law assigns INTI several responsibilities, such as to maintain and to transfer by means of its calibration services the National Scales and Standards, to create other calibrations centers, and to oversee the Argentine Legal Metrology System.

3. METROLOGY IN THE ELECTRONICS DIVISION OF INTI

The Electronics Division comprises three groups with the following duties:

1 - <u>Electronics design and microprocessors group</u>.
It works in the design, construction and testing of special equipments and the introduction of automated measuring systems based on microprocessor control.

2 - <u>Industrial and fundamental metrology group</u>.
Its objective is to assist with calibration requirements, to establish the most adequate measurement procedures, and to keep the high frequency national standards covering the range above rf.

3 - <u>Radiointerference characterization and measurement group</u>.
It studies problems caused by industrial activity as far as radiointerference is concerned and in particular that generated by automobile ignition systems.

Starting from experiences obtained in countries like West Germany and the USA over a period of 70 years in Institutes like PTB or NBS, we faced the problem of how to establish a metrological system to contribute to development of the national industry. The decision was to transfer to industry the technological advances through several types of services (for instance, calibration services), developing at the same time

fundamental metrological techniques with the purpose of maintaining and transferring the national scales and standards.

4. ACTIVITIES OF THE INDUSTRIAL AND FUNDAMENTAL METROLOGY GROUP

The group verifies and calibrates working standard instruments to be used in industry in production process or quality control. Since 1975, it has calibrated electronic instruments to be used in the maintenance of airnavigation equipments, because F.A.A. (Federal Aviation Administration) demands that all airnavigation enterprises that fly over the USA must have their instruments under metrological control. At the same time, the Airplanes and Technical Department of the Argentina Air Force demands that all factories (about 15) that operate under its jurisdiction keep their instruments calibrated. In order to illustrate the rate of increase of our activities, about 300 instruments were calibrated during 1977 as compared with 100 instruments only three years earlier.

Also, this group controls communication equipment jointly with the Secretary of Communications. The latter has recently established a national register for telecommunication equipment to certify national and foreign prototypes and has requested INTI collaboration to develop this line of work.

This wide range of activity promotes the "Argentine System of Calibration" project, that covers not only electronics but other fields, too, that seeks to decentralize calibration activities, promoting the development of other calibration laboratories all over the country. Agreements were established with the Faculty of Engineering at the University of Rosario in the province of Santa Fe as well as with the Faculty of Engineering at the University of Cordoba in the province of Cordoba, to attend to local metrological needs and to certify instruments.

One of the most important duties of the Electronics Metrological Group is to develop and to keep the national standards. For that reason it was decided as a first step to obtain commercial standards with certificates of calibration from well recognized institutes and as a second step to attempt their development in our own laboratories. This criterion was applied to voltage, attenuation, impedance, power and frequency.

5. ACTIVITIES OF THE RADIOINTERFERENCE MEASUREMENT GROUP

This group began to work about a year and a half ago. Some neighborhoods in Buenos Aires city have too many difficulties in the establishing communications due to the presence of industrial radiointerference. As a consequence INTI was assigned to study this problem and to attempt to solve it. Almost at the same time the automobile factories found that many of the countries to which they export Argentine made cars had regulations limiting the amount of radiointerference due to ignition systems. As a consequence they requested INTI to study and to solve the problem. This line of work is now being developed jointly with the Secretary of Communications, and having concluded a first stage of measurements, we are presently evaluating results.

This is a synthesis of our work and our projects in the Electronics Metrological Laboratory in INTI. We intend to establish a strong metrological basis to have a powerful industry.

PAPER 2.5 - PROGRAMS OF IPT

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1. IPT AND INDUSTRIAL QUALITY CONTROL

My topic is what IPT is doing and will continue to do for quality control and the improvement of production. These activities fall into five main areas:

(1) Training.
(2) MAPs (Measurement Assurance Programs).
(3) SRMs (Standard Reference Materials).
(4) Collaborative programs.
(5) Quality assessment.

From the items listed, you can be sure that the NBS influence was paramount. And this is true. We just are finishing at the end of this month a long project with NBS.

Training is quite straightforward. It is not academic training. It is industrial training, because IPT works for and with industry. So our training takes people from industry through some specific problems.

Measurement assurance programs (MAPs) are a new area of action that we are trying to develop, and that is my job. These programs are being developed at home, inside IPT, before being offered as a service to other institutions.

Standard reference materials (SRMs) we are just beginning to produce. We started out a program on metallic samples -- steels and brass and bronzes. We plan to go on with other materials. We are producing SRM's, and have now about 15 types which are being sold commercially to all Brazil. In this program we have 20-30 laboratories analyzing our samples and getting harmonization of data. NBS has taken part in some analyses, also BIPM in Paris. We would like to have more participants in our program, so that we can make a general standardization in this area.

We have a number of collaborative programs in other areas than standard reference materials. They are in the area of material testing. We have eight different programs -- cement, aggregates, paper and cellulose, rubber, plastics, etc. -- and we have about 100 laboratories taking part in these programs. This work is quite interesting and quite useful. People are learning a lot, and we are pushing these programs ahead, for the advancement of our Institute and of Brazil.

IPT is taking the first steps in a quality assessment program, whereby IPT is going to assist industry to evaluate the products from the design to the selling stages. We start out with the selling specifications, then we go to recommendations on design, and standards, and eventually to the entire production process. This program is quite new. We are just in the first stages to see if we can find some customers for this approach, since this will be a very expensive program. It seems that it will be very useful, so we are just waiting anxiously to see how industry will reply to it.

I would say of the present programs that industry in Brazil has a good confidence in IPT. IPT has been serving industry for 78 years. They trust IPT, and if they don't trust IPT, or IPT makes too many mistakes, then we are out of business.

2. IPT -- CHALLENGES AND OPPORTUNITIES

A brief background discussion is necessary to understand the reasons for the title of this section. The situation is uncommon, perhaps unique, and it may be opportune to provide a description of some of our experiences. A good starting point is the fact that IPT has never been an official agency; this means that IPT cannot enforce anything. Our institution always has worked as a support to industry, and our services are looked for on a basis of excellence. If there is some demand for specific kinds of tests, IPT will equip itself to perform them. Probably no other institution can do a new or unusual job as easily as IPT, because the Institute is always looking for new areas of action.

The history of IPT, with a long record of technical excellence, brings with it some responsibilities. It is fully realized that IPT must permanently be making efforts for improvement. This is the reason why we have "challenges and opportunities." Against this background I will describe in more detail the IPT measurement assurance program.

Some years ago it was decided to expand the overall capabilities of IPT, and NBS was looked to as a source for guidance [1]. An agreement was signed starting a very ambitious program. Incisive comments made by Dr. Huntoon [2] led to the decision to open up a new type of service.

The IPT basic output for industry is test certificates, more than 20,000 per year. The tests range from routine jobs to rather difficult problems. And the results are always obtained by some kind of measurement. The question comes up at once: what kind of confidence do the results on the certificates deserve? The problem is very important, being official agency or not.

The first step was the analysis of measurements made by IPT to try to group them. A decision was reached to create five central measurement stations. These stations are for measurements of length, mass, force, thermodynamic, and electrical quantities. The decision is logical because many technical divisions of IPT work with one or more of these physical values and the test results must be certified. The need to establish traceability to our internal central stations is then obvious. And our central stations can comply with official requirements for all legal aspects.

ITP has previously placed efforts on measurement assurance. Equipment was and continues to be calibrated, following approved routines. What is quite new and is not operative yet is the new measurement assurance concept, to guarantee compatibility of all measurements. A follow up is mandatory to guarantee that results are maintained, and this situation is also unique. A central station cannot reach IPT as a whole. A centralized coordination is necessary, to reach all divisions and eventually enforce some corrective steps, unpleasant as they might be. The follow up will be in the form of randomly programmed inspections [4]. As this program is just starting, no specific rules or procedures are available.

All the steps already taken or to be adopted are internal to the institution and have a common objective. The overall objective is to guarantee that certificates are meaningful, as regards accuracy and precision. And within the institution some additional steps are now obvious. Their usefulness could at one time be doubtful, but now their adoption seems logical.

The first step is a certificate auditing program, and centralization is again functionally quite important. The best point to check a system is in the output, certificates in our case. The auditing is to be random, and must reach all areas to be effective.

The second step is that requests for additional capability can be analyzed as a whole. In each case the request can be matched against the respective central station, and a more efficient decision can be reached. A central coordinator, even though not executive, may prove useful.

The only connection with others, so far, has been through certificates. If IPT adopts a language, it must be sure to have it understood, because it cannot be enforced. Also, legally mandatory, it will be necessary to check against a national standard, if there is one.

As IPT works in close contact with industry, a natural development is the sponsorship of collaborative programs. This is also a new area closely related to measurement assurance. Such programs are important because they represent to some degree an extension of the national measurement system. IPT has nine programs already going on with about 200 collaborating laboratories, and a new set of questions comes up.

How to evaluate test results? What test methodology to adopt? How to include deviations, and so on. A program coordinator is quite helpful but is not the solution. His action is important towards the establishment of a common procedure and language.

The collaborative programs have an arduous path, because it is easy to misunderstand the objectives. It is quite convenient to have information available so it can be handed out during meetings. Information in foreign languages is helpful, but does not work very well. This means that additional work must be done, namely the translation of the information. And it seems necessary to emphasize that a mere translation is not sufficient. Information must be understood and complemented before the translation, a job to be handled by the program coordinator.

This is again a unique situation, because IPT is sponsoring these collaborative programs. This means that the pioneer effort must set the path and that all details of each program must be worked out by IPT. This includes the written procedures and methodology. It seems best to indicate that each case is an individual case by itself, requiring specific care, because on a first time job always happen first time errors and problems. Some facts may have become obvious by now, and it seems appropriate to mention them.

The first fact is that reliable measurements are not the results of laws. They come out of hard and conscious labor. A favorable set of laws is helpful, as it brings out a receptivity for these problems.

Secondly, reliable measurements do not come out by themselves. A reliable measurement must be used and is the outcome of some kind of social pressure. The need for them can be anticipated but not artificially created. Also, as a society progresses, more and more reliable measurements are necessary, even though not mandatory or legal.

The two facts above have a direct bearing on quality assessment and quality control. Without a need and without reliable measurements, efforts in this area are wasted. IPT realizes that actual conditions are favorable to improvement in this area, again increasing the challenges and opportunities for action.

Last, but equally important, is the fact that such programs must be delivered to industry, "sold", or reach the potential users, both inside and outside the institution. This means that the technical information must be easily available, so as not to discourage interested persons. And the source of the information must be able to explain and answer questions from persons with different backgrounds. Translation alone is unsatisfactory. There is a saying in my country, which in well educated terms says -- that if you do not know what you are doing, you are lost.

References

[1] Florez, R. G., The state of Sao Paulo Program for Science and Technology - PROCET (Programa Ciencia e Tecnologia) - a brief description - Report to AID on an NBS/AID Workshop on Standardization and Measurement Services NBS Publication NBSIR 76-1152.

[2] Huntoon, R. D., Needs and opportunities in metrology of the Instituto de Pesquisas Tecnologicas for effective support of Brazilian industry (Report to be published by NBS).

[3] Huntoon, R. D., Standard reference materials and meaningful measurements: an overview - SRMs and meaningful measurements (NBS Special Publication 408).

[4] Cox, D. R., Planning of Experiments (John Wiley and Sons, New York, 1958).

PAPER 2.6 - STANDARDIZATION AND MEASUREMENT SERVICES IN INDONESIA

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I. CURRENT STATUS OF STANDARDIZATION AND MEASUREMENT SERVICES IN INDONESIA

The standardization and measurement services in Indonesia, which lack a central guiding system, are still unconcentrated efforts. Mentioned below are the following developments.

1. STANDARDIZATION

A significant post-war development, the Standardization Institute "Stichting Normalisatieraad", was founded in December 1948. It was modified into the "Foundation for Indonesian Standards Fund" (YDNI) in April 1954. This is a private organization, installed by the Association of Indonesian Engineers, which has also been admitted as the Indonesian member of ISO and IEC.

In order to meet the urgent requirements of economic development, several departmental and non-departmental organizations have been engaged in standardization activities:

Dept. of Health:	Pharmaceuticals and food stuffs
Dept. of Industry:	Industrial products
Dept. of Public Works:	Building codes
Dept. of Trade:	Export commodities
National Institute of Science:	Basic standards and development of national standardization system.

A law of commodities enacted in 1961 empowered the government to impose compulsory quality control on manufactured goods, commodities for export as well as imported articles. However, this law cannot be put into effect, since a statutory decree as a means for deliberation and execution is lacking.

2. MEASUREMENT AND CALIBRATION

Indonesia has adopted the metric system of measurement, by a weights and measures law which was issued in 1949.

Measurement and calibration services are given by the following organizations:

National Institute for Instrumentation: engineering metrology

National Atomic Agency: nuclear measurements

Metal Industries Development Center (MIDC): engineering metrology

Directorate of Metrology: weights and measures

Electric Power Research Institute: electricity

Telecommunication Research Laboratory: time and frequency

Material Testing Institute: force and pressure

Traceability to international standards is maintained through:

Directorate of Metrology: weights and measures

National Atomic Agency: nuclear measurements

MIDC (through Belgium): length and angle

Electric Power Research Institute (through Japan): voltage and resistance.

3. NATURE OF STANDARDS

The use of standards formulated by YDNI and the other organizations mentioned above is entirely voluntary, except in those instances when the reputation of the country is endangered through unsatisfactory quality or where the risk to public health and safety can cause the standards to be declared compulsory, e.g.:

- Crumb rubber for export
- Essential oils
- Pharmaceuticals
- Certain food stuffs

4. COMPANY STANDARDS

The benefits of standardization can be realized only when the standards are put into practice at the company or in-plant level. The Department of Industry has taken initiative steps towards the promotion of in-plant standards activities. Technical assistance from the Federal Republic of Germany has been received to help the promotion of in-plant standardization activities.

5. NATIONAL SYSTEM FOR STANDARDIZATION AND MEASUREMENT SERVICES

A National Survey on standardization and measurements was conducted and sponsored by the National Institute of Science and NBS in 1977. The following developments have taken place since then:

a. An agreement between YDNI and the National Institute of Science has been signed to expedite the establishment of the national system for standardization. Mentioned in the agreement is that:

- The joint management of international affairs (ISO and IEC membership) should cope with financial and official problems.

- Establishment of LIPI - YDNI Secretariat in Jakarta.

b. The preparatory committee for the establishment of a national standardization system has been set up and will be instituted by the Decree of the State Minister for Research and Technology. It is envisaged that under this system coordination and programming will be centralized, whereas the execution of formulation and implementation of a standard will be conducted by the organization and department concerned.

c. The National Calibration Committee has been set up by the Decree of the Chairman of the National Institute of Science. The members of the committee consist of representatives from, e.g.,

Department of Defence
Department of Industry
Department of Energy
Department of Communication
Department of Trade
National Atomic Agency
National Institute of Science

d. A Network of Calibration Services will be established in the near future which will include nine Calibration Centers dealing with weights and measures, electricity, nuclear quantities, time and frequency, and engineering metrology.

Acknowledgement:

I wish to thank and express my sincere and grateful appreciation to the Government of the USA and the National Bureau of Standards for having given me the opportunity of attending the NBS Workshop on Standardization and Measurement Services. It will certainly be beneficial in the improvement of standardization in my country. Thank you.

II. THE STANDARD PROBLEM FOR DEVELOPING COUNTRIES

We are in the standards environment. We are together, among people from different fields of work, but all closely connected to standards. If we look at the results, or the Proceedings, of the 1977 NBS/AID Seminar on Standardization in Support of Development, I think we can see the standard problem for developing countries: problems of education; problems of promotion of awareness or

consciousness; problems of facilities; and problems of the system for development.

I am here to give a small contribution to the United States as background data for the Science and Technology Conference of the United Nations. However, please note that whatever I say on this occasion is only my personal opinion, and does not necessarily represent the views of my Government, of either Government.

I would like to prove to you that the standard problem for developing countries really exists, especially in Indonesia. I would like to share only one specific experience and problem area concerning science and technology standards and measurement services.

It is not questionable, perhaps, that science and technology for both developing and developed countries are very important. In Indonesia, a new minister has been installed in the present cabinet, the State Minister for Science and Technology. His task is to coordinate the activities of research and science and technology, to make it a concerted effort to support our development. Recently, about a month ago, a new agency was established, the Agency for Assessment and Application of Technology. It is headed by the Minister himself, the Minister for Science and Technology. I think that should show you the importance that science and technology organization has for our development.

The Minister has a new definition for "technology", which is, "technology is any activity that supports development, and, in short, technology is skill."

The Minister's first step after his appointment has been setting up five National Committees, namely, the National Committee for Basic Human Needs; the National Committee for Resources and Energy; the National Committee for Industrialization; the National Committee for National Security and Defense; and the National Committee for Sociology, Economics, and Philosophy. The tasks of these Committees are to coordinate, evaluate, and monitor research activities conducted in four different national sectors, that is, the departmental research institutes, non-departmental research institutes, universities, and private organizations. Also, these Committees are to formulate the national program for research and technology to support the five year development plan.

We have already launched the national program for standardization, calibration, instrumentation, and metrology. We call it the SKIM program. That is also coordinated by the Minister for Science and Technology. But we don't have a National Institute for Standardization, and we don't have a National Measurement Laboratory, like NBS, yet. All the activities are still scattered among several institutes belonging to different departments.

Now, I want to give you a specific problem, faced by one of the institutes in Indonesia, just to prove to you that the standard problem faced by a developing country does really exist.

It is a problem of experience in calibration or measurements of testing machines. I have been working in a materials testing institute for ten years. The problem is, that we do have the apparatus for calibration of testing machines, but the apparatus that we have is more or less outdated. We have proving rings, *certified by NBS in 1937, and never calibrated since then*. But we have to do the testing, we have to do the measurements, we have to do the calibrations, just to have a single or a uniform measurement results pattern for any testing done in Indonesia. So the problem is, how can we have true traceability to national standards?

The second question or issue that I would like to raise, is that, being limited in economic and skilled manpower resources, we have been faced with appropriate problems in other areas, for example, priority setting, appropriate technology, and information systems. During our Workshop this year we were shown the NBS data base and information acquisition network, which to my thinking, will accelerate and economize research and development effort. Based on the situation in my country, and my findings during my short visit in NBS, I would like to take this opportunity to raise a question. You possess

an abundant source of information on research and technology, nicely classified and disseminated, using the latest sophisticated technology, as has been demonstrated to us. This will really accelerate the development of technology, and if the information can also be made available to us, it will greatly help us in economizing our effort, as for example, in reducing unnecessary duplication of work, and in directing the course of action.

If I understood correctly, you have been doing mathematical modelling in the Measurement Assurance Program (MAP), taking into consideration the actual situation, to predict the design of a MAP program. Perhaps this could be extended to the problem of technical cooperation between the United States and developing countries, by designing a mathematical model, the same way as has been done in the MAP program, so that we could find the most suitable system of technical cooperation.

I will conclude my contribution by asking you point-blank, is it possible for us to acquire information from your data base and network, and how? I think that is the main point to raise in this presentation.

DISCUSSION:

Dr. Sangster (Seminar Coordinator and Editor) (note added during editing):

The NBS data base and network are accessible by all. The ease, speed, and costs of access depend upon the specific information desired. Much is available without charge. Some is accessible only on a cost-reimbursable basis. Inquiries from abroad should be directed to the NBS Office of International Relations.

PAPER 2.7 - PRESENT STATUS OF ELECTRONIC MEASUREMENT STANDARDS AND CALIBRATION SERVICES IN INDIA

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In India, electronics is playing a very vital role in areas such as telecommunications, broadcasting, navigation, space research, defence, industrial process control, consumer electronics, etc. The electronic industry is now on the point of take-off, and a variety of professional grade electronic products including sophisticated instruments/equipment and systems are being commercially produced in the country. Our annual production is in the range of $500 million, with a 15-20% annual growth rate. To meet the growing demand of precision electronic measurements for the purpose of calibration of instruments as well as quality control, reliability evaluation, and interchangeability of products, a national system of electronic measurement standards, calibration, and testing has evolved over the years. Several organizations, both Government and non-Government, are engaged in this task. The documentary standards or specifications are prepared by the Indian Standards Institution and the Electronics Components Standardization Organization, a Defence Organization. The realization, maintenance, and up-dating of the national measurement standards for all physical parameters including electronics, is the responsibility of the National Physical Laboratory, New Delhi, under the Council of Scientific and Industrial Research. The organizations engaged in the electronic measurement standards, calibration, and testing have been grouped into three echelons described below:

Echelon I

This is the apex level providing the highest accuracy of measurement. The National Physical Laboratory, New Delhi, is the custodian of Echelon I Standards (National and Transfer Standards) and also provides the calibration services to Echelon II laboratories/centres.

Echelon II

Echelon II Measurement Standards and Calibration Services are offered by four Regional Calibration Centres and Defence Calibration Laboratories. The standards maintained by these laboratories are classified as 'Reference' and 'Secondary Standards' and are periodically calibrated against Echelon I Standards. Apart from periodic calibration services to Echelon III laboratories/centres, Echelon II laboratories also undertake specialized testing against Indian Specifications and Joint Services Specifications and reliability evaluation under various environmental conditions.

Echelon III

Echelon III Calibration Standards are maintained by the State Test and Development Laboratories, Test Laboratories of Indian Standards Institution, recognized research laboratories/academic institutions, and some public sector industries. These laboratories undertake calibration of test instruments of industries and educational institutions and also provide test facilities for evaluation of industrial products against Indian Standards Specifications.

The international traceability of our national measurement standards has been established through periodic calibration by the International Bureau of Weights and Measures and some measurement laboratories of other countries. The present status of the Echelon I Measurement Standards of some of the electrical and electronic parameters at the National Physical Laboratory, New Delhi, is summarized in the following table.

Table

Parameter	Techniques Used	Accuracy
1. Time and Frequency	Portable Cs Atomic Beam Standards	7 parts in 10^{12}
2. D.C. Voltage	Bank of Standard Cadmium Cells maintained at 20°C ± 0.001°C	1 part in 10^6
3. D.C. Resistance	Bank of One Ohm Standard Resistors maintained at 20°C ± 0.001°C	1 part in 10^6
4. Capacitance	Standard Capacitors	2 parts in 10^6
5. Inductance	Standard Inductors	1 part in 10^4
6. A.C. and L.F. Power	Non-portable Electro-dynamometers and Electronic Power and Energy Meters	.05% to .1%
7. A.C. and L.F. Ratio	Inductive Voltage Divider	5 parts in 10^8
8. H.F. Voltage	Thermal Convertors and Micropotentiometers	.05% to 3% (depending on the voltage frequency range)
9. H.F. Attenuation	Waveguide beyond cut-off (30 MHz)	.005 dB/10 dB
10. H.F. and Microwave Power	Calibrated Power Meters	1% to 2%

Some of the areas in which work is already in progress at N.P.L. to up-date the abovementioned standards, are listed below:

1. Josephson Voltage Standard.

2. Calculable Capacitor.

3. Capacitance to Inductance transfer techniques.

4. A.C. and L.F. Voltage Standards based on multi-junction thermal convertors.

5. H.F. Voltage standards based on 'Bolovac'.

6. H.F. and microwave power standard based on dry load calorimeter and micro-calorimeters.

7. A.C. ratio based on Inductive Voltage Divider.

8. H.F. Attenuation Standard based on W.B.C.O. (.001 dB/10 dB).

We have been quite lucky, getting assistance from various international organizations, such as NBS, PTB, NPL-Teddington, and VNIIM of exchange of information, supplies, in terms of equipment, and training of manpower. Our strongest asset is our trained manpower. We have the third largest technically trained manpower in the world today, so there is no problem at all in terms of trained people, both at the upper level and at the middle level.

Some of the problems which we are facing at present are that precision measuring instruments are not yet being manufactured in the country, so we have to depend mostly on imports; and that, because of the long distances involved, we have the problem of transportation of the measurement standards after calibration. Also, there is a lack of consciousness in the industry towards precision measurements. We are working on a national calibration service, so that we can interlink all the industries, the testing laboratories, the Echelon II calibration centers, and the National Physical Laboratory, in a well-organized national system.

As I mentioned, our electronics production is about $500 million per year, but it is mostly for in-country consumption. We export very little, only of the order of 10%. We would like to export more and more. We have established the Export Promotion Zone near Bombay, where we invite both Indian and foreign companies to establish production units/assembly plants exclusively for export.

DISCUSSION:

Mr. Hamilton Herman:

Do you get adequate, consistent financial support from the Government? Are each of you able to maintain a reasonably consistent, independent position, independent of politics?

Dr. Chandra:

During the last three to five years, emphasis on quality control through standardization and metrology has greatly increased. Although more funds are being made available for these activities, they are still not quite adequate. We are trying to get more financial support through various Government agencies.

Mr. Gandhi:

We have been faced by a bigger problem than standardization and quality control. It is the needs of human beings--food, clothing. I think we haven't had enough support from the Government, but as I have told you, recently, a new Minister has been installed, a Minister for Science and Technology, and this new Minister has the task to coordinate and to evaluate our program in science and technology. This includes also the program for standardization and quality control. So I think that by having the say from the new Minister to the National Planning Board, I do believe that in the near future more support will be given by the Government.

Mr. Mazza:

Really, we have some problems, but I think that our country is growing, in all senses. We have created some consciousness about quality control and metrology, and I think that in maybe not so long a time we can create a good industry.

SECTION 3 - NATIONAL AND INTERNATIONAL STANDARDS
THAT MUST BE SATISFIED BY INDUSTRIALIZING NATIONS

Chairman: Dr. Khaled Y. Al-Khalaf, Director General, Saudi Arabian Standards Organization

PAPER 3.1 - STANDARDIZATION IN THE DEVELOPING NATIONS

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1. ADVANTAGES OF STANDARDIZATION

1.1 Planning of the attainment of a given objective need not be repeated each time.

1.2 The concepts in the minds of the parties concerned are given definite meanings.

1.3 More economic use is made of human effort, material and time; hence, there is lower cost of supply and distribution of goods and services.

1.4 The variety of means necessary to cover a given range of needs is minimized.

1.5 Interchangeability is achieved of component parts, assemblies and complete products, making possible long-run, highly repetitive manufacturing, facilitating repair and replacement.

1.6 Easier training or retraining of personnel, by means of instruction sheets, manuals, etc., is facilitated.

1.7 Confusion and conflict between individuals and groups are eliminated, resulting in their more harmonious and effective working together.

1.8 A rational basis of understanding in contracts is created.

1.9 Fair dealing in trade is promoted.

2. THE STANDARDS PICTURE (NATIONAL, REGIONAL, AND INTERNATIONAL)

2.1 National Standards

The rate of development all over the world and the keenness of international trade clearly show that the economic development of a country must have as its constant companion machinery for ensuring high standards of quality and accuracy for both its indigenous products and imported equipment and commodities. Such machinery can help the country to hold its home market and to earn a fair share of the export market in order to bring in much of the foreign exchange needed for its further development. This is achieved through national standardization, which is the most important tool for promoting industrialization and for supporting economic progress.

When national standardization starts by the adoption of foreign or international standards, some developing countries may find it difficult to apply such standards without modifying and adapting them in the light of their existing facilities and actual needs. This varies with the actual stage of development, the extent of economic, scientific, and industrial progress, and the relations with other countries as regards imports and exports. Nowadays, many developing countries have their own national standards.

2.2 International Organizations

a) International Organization for Standardization (ISO). The objective of this organization is the development of standardization in the world in order to facilitate the exchange of merchandise between countries and to realize mutual understanding in the intellectual, scientific, technical, and economic fields.

b) International Electrotechnical Commission (IEC). The objective of this Commission is to facilitate the coordination and unification of the national standards in the electrotechnical fields and

also to coordinate the activities of other organizations in this field. Its mission is to establish technical recommendations to ensure the coordination of standardization on the national and regional scale.

2.3 The Need for Standardization at the Regional Level

Regional standardization is an intermediate stage between national standards and international standards. It makes no claim to replace either type of standard, but rather bridges the gap in the application of international standardization to the needs and possiblities of countries in a given area, harmonizing the standards of those countries and fitting them to the circumstances peculiar to the area. The special function of regional bodies enables them to speed up the internationalization of standards, taking into account the limits and reqirements which hamper immediate implementation of international standards within national boundaries or within the regional boundaries of a group of countries. The vast difference between their level of development and that of the industrially advanced countries, as well as the inequalities between countries in the same zone, has created a need for bodies which, by following the procedures applied in international standardization, will be able to adopt at an intermediate level standards that are appropriate for regional exchange. This task of the regional bodies does not preclude the possibility of adopting international standards on certain subjects or which produce certain effects, so long as the interests of national and regional development are borne in mind.

Regional standardization has certain specific objectives, *inter alia*:

a) To promote national standardization in all countries of the region concerned, giving due consideration to the special circumstances prevailing therein, and to endeavour to obtain information, training and assistance for those countries.

b) To coordinate national standardization in the countries of the region so as to harmonize it progressively in order to facilitate exchanges and integration at the regional level.

c) To contribute to the establishment of national and regional programmes for the creation and transfer of technology.

d) To facilitate quality control in the external trade of the region.

2.4 Regional Organizations

2.4.1 European Organizations

The International Commission on Rules for the Approval of Electrical Equipment (CEE) is composed of organizations in European countries, which, in the interest of the public, especially with respect to safety, issue rules and regulations for electrical equipment (cables and flexible cords, accessories and appliances) and check compliance therewith. CEE specifications are mainly concerned with safety requirements and, while not formally binding on member organizations, the appropriate authorities in their countries are strongly recommended to adopt the CEE specifications as far as practicable. Owing to the special circumstances, however, some member organizations will not be able to accept all the requirements of these specifications. The CEE specifications are in force in any country only in respect of those items of equipment for which the corresponding national specifications of that country are in agreement with or are accepted as equivalent to those CEE specifications.

The European Committee for the Coordination of Standards (CEN) has as its objective establishment of standardization documents common to all the countries of the European Common Market and those of the European Free Trade Association. In order to eliminate the technical obstacles to the exchange of products between the countries of the European Economic Community and those of the European Free Trade Association, it is necessary to suppress the eventual divergencies between the national standards.

The aim of the European Committee for the Coordination of the Electrotechnical Standards (CENEL) is to decide on the ways for harmonizing the recommendations which could be reached in the electrotechnical field. The activities of this Committee are mainly based on the result of the work of both IEC and CEE.

2.4.2 Arab Organization for Standardization and Metrology (ASMO)

ASMO is a technical organization under the aegis of the League of Arab States, responsible for standardization, metrology and quality control. The aims of this Organization include:

- Raising the level of production and ensuring the high quality and precision of Arab industry.
- Promoting cooperation between Arab states in the fields of the economy, industry, agriculture, science, and culture through the elaboration of unified standards and measurements.
- Promoting commercial exchange between the Arab States and developing exports.
- Helping the Arab States and countries in creating, completing, and developing the national bodies for standardization and metrology in order to strengthen the role of standardization in supporting their economic plans and development programmes.
- Issuing recommendations and unified Arab standard specifications for materials, apparatus, equipment, and systems for technical execution.
- Coordinating unification of terminology, symbols, and definitions, and methods of inspection, analysis, and measurements together with measures to be taken for quality control and for checking conformity with specifications.
- Establishing a joint Arab centre for training in the fields of standardization, metrology, and quality control.
- Establishing a documentation and information centre for the dissemination and exchange of all information, publications, and research in the field of standardization and metrology.

3. THE ROLE OF STANDARDS IN A DEVELOPING ECONOMY

In the complicated mechanism of the modern world, the interactions which take place despite the distances involved and despite different levels of development require that careful attention be devoted to the weakest links in the chain of causes and effects. Transition to a more developed society is more important than simple economic development; however, such economic development is the essential prerequisite. Some scholars have said that the formula for economic development is quite easy: it consists in marshalling sufficient resources for the development process, the development of industry being the key element. The problem is, however, that the poorer the society the more difficult it is to find resources for the development of industry; hence, societies with very limited means of subsistence are virtually condemned to stagnation, precisely because of their poverty.

The most important surplus a society can have is in the industry of knowledge, i.e., that part of society devoted to increasing and to disseminating scientific knowledge. If this industry is large enough that a production surplus occurs (bearing in mind inevitable drops in production during bad times), the society cannot but develop. A society's capacity to develop depends to a very large extent on the volume of resources which can be used for educational and research purposes. At the time of Adam Smith, the encouragement of well-organized research aimed at increasing knowledge and improving production methods was already recognized as being of great importance to industrial development.

Developing countries lack the experience they need to make use of technological discoveries in order to increase production and thus achieve better use of the production factors: raw materials, equipment, methods, manpower. In the highly industrialized countries, on the other hand, rational use of these factors has made it possible to build up efficient industries with high levels of production, capable of competing in the international market on the basis of good quality. Balanced economies have the advantage of outlets into world markets where competition is based on quality, price, and suitability. The more developed countries are also in a position to satisfy, in adequate quantities, almost any market on the basis of intensive use of capital goods in the production process. This is the very thing the developing countries are unable to do.

It might seem that there is only a small margin in favour of industrial growth in countries of low economic development, and this is in fact true in sectors where competition is based on taking commercial advantage of the most recent advances of technology, although not in the wide sectors concerned with the production of basic goods needed by the society as a whole, particularly foodstuffs, energy, metal and nonmetal materials. These sectors offer so many other possibilities for economic development that, if proper use is made of them, they will provide the means for our societies to evolve at a rate which may surpass that of the industrialized nations and which is necessary in order to diminish the present differences in levels of development. There are conditions which must inevitably be met, necessary patterns of evolution, elements of knowledge and experience to be provided by the highly developed societies and which will have to be adapted to the specific local conditions and peculiarities.

Technical standardization represents a sum and a summary of the best achievements of science and technology, which if associated with the practical experience of the most advanced countries, will bring about rationalization of production, leading to better economy of the production factors and reducing losses, waste, repetition, safety hazards, and the whole succeeding series of negative effects for industry. Standards institutes open the door to improved knowledge of progress and experience throughout the world. They act as arbitor between the conflicting interests of producers, consumers, and the general public. This is of paramount importance in finding a proper balance after decades of mutual ignorance have built up all kinds of barriers and obstacles, making it very difficult to achieve the mutual collaboration which is indispensable for countries who wish to move forward in a single constant direction.

4. THE ROLE OF STANDARDIZATION IN TECHNOLOGY TRANSFER

License agreements are becoming very important in the international marketing of technology. In connection with standardization, one essential aspect of this development plays a vital role in the planning and practical implementation of industrial projects.

Licenses relating to technology are a complex subject. Conditions vary considerably from one country to another, and the effect produced by foreign technology varies accordingly. There is, however, some similarity in the basic programmes for international license agreements, in particular, as regards adoption and the negotiation leading to adoption.

It must be supposed that, as those countries develop their technological background, the sum of their specialized knowledge on international transfer of technology will increase. It must not be forgotten that a license agreement is the result of bilateral negotiations, that it is precisely this instrument which regulates relationships between licensor and licensee, thus ensuring that the validity and scope of the license will comply with the laws in force in the country where it is to be used.

It is important to define or identify the objectives, the specifications and the methods used in conjunction with the technology to which these negotiations pertain. Generally speaking, developing countries acquire foreign technology at the company level, that is, through transfer from one company to another. There can be no doubt about the licensee's desire to obtain the appropriate technology under the most favourable conditions; yet, it has been observed that the cost profit analyses are made essentially in relation to the economic situation of the company.

Now, the choice of a given technology clearly affects the overall economic and social development of a country. This is why the governments of the developing countries have defined basic principles which the individual agreements for technology transfer must follow.

In order to encourage technology transfer to developing countries, it is very important to abide by certain fundamental rules such as

the following: The flow of technology must be capable of satisfying the basic requirements of industry and of filling in any gaps at the production level, and must be associated with the industrial programmes. Specific guidelines and appropriate standards and specifications should be laid down which take account of the requirements and characteristics of both the home market and the export markets. On the other hand, it must be possible to assimilate the foreign technology quickly and efficiently and adapt it to local conditions. To achieve this, priorities should be established and guidelines for selection followed to make it possible to acquire know-how and goods in a consistent, coordinated manner.

The development of technical services should be regarded as one of the primary objectives of a developing country's policy, so that, progressively, there will be greater participation in the planning and implementation of industrial projects.

There is a decided difference, in practice, between the type of license agreement drawn up between two companies in highly industrialized countries and the type entered into between an advanced country and a developing country. This difference stems from the fact that the less industrialized country is at a much lower level of technical development than the highly industrialized country. In the case of developing countries, it is very important for the licensor to take an active part in planning an industrial project and in carrying those plans out. It has been demonstrated that highly sophisticated technologies may not be wholly suitable because they are designed for large-scale production and, in most cases, not only is the home market of a developing country restricted, but distribution networks are quite inadequate. The choice of machinery and equipment, as well as the type of technology best suited to local conditions, is largely dependent on the scale of production.

Although during the preliminary negotiations it may be difficult to assess the true value of all of the elements included in the technological aspect, it is essential for the licensee company to gather the information it needs to be able to determine the cost, both direct and indirect, of the technological processes available from different sources throughout the world. In general, the licensee should try to find out the expected lifetime of the technology, the characteristics and limitations of the equipment obtainable from the different suppliers, and also the amount of money companies in other countries pay for the same know-how.

From the experience of developing countries it appears that guarantees which have to be accepted by the different companies call for special attention on the part of their governments. In this connection, it is important for the license agreements to stipulate that the technology concerned is capable of achieving given levels of production, and to include guarantees regarding the quality and characteristics of the products.

The government's role in this sphere will be to define the specific objectives and to determine the type of technology and equipment to be imported and on what conditions, including how much adaptation will be required in order to bring industrial development plans to success. This role, which involves heavy responsibilities, will require government policies to take account of the type of infrastructure -- both financial and economic -- needed in a given sector of industry; furthermore, there will have to be a broad economic policy which clearly defines the objectives and limitations of the country.

The developed countries need to improve the technical competence of the licensee countries in the following subjects in particular:

a) The development of standardization methodologies with a view to selection and adaptation of foreign know-how.

b) The development of equipment standards to be complied with by all suppliers of technology.

c) The training of local technicians so as to obtain technical assistance and information from abroad.

d) The creation of interdisciplinary centres in the field of standardization as an integral part of a scientific and technological infrastructure.

e) Technical assistance with matters concerning quality control of foreign equipment and services, such assistance being geared to the technical abilities of the licensee countries.

5. IN-PLANT STANDARDIZATION OF DEVELOPING COUNTRIES

While the principles of standardization are of general validity, their application in areas of activity of a manufacturing enterprise depends upon conditions which vary from country to country, from industry to industry and also from one location in industry to another. In developing countries, such factors as foreign collaboration, shortages of material and the like, are additional considerations to be taken into account when formulating specific standardization programmes. The problems that any company faces will eventually be minimized by the establishment of an organized in-plant standardization programme, since the programme requires that once a recurrent problem is recognized and solved, the solution should always be recorded. The company will find it easier to establish better relations with its suppliers in the long run because they will realize that the company with a standards activity does not rely on guess-work and that its demands are stable. It will be in a better position to convince government authorities of the genuineness of its material and manpower requirements, and in the case of a subsidiary, to convince the "principals" in foreign countries that its requests are valid in relation to certain foreign standards requirements, which may otherwise be unnecessarily stringent if applied without regard to local conditions.

Advantages of in-plant standards:

a) More time may be devoted to the fundamentals of design, when prolonged concentration is given to a few good designs, rather than hurried attention to a succession of minimally workable ones.

b) Product designs may be simplified and the relations between product and process requirements studied more closely. More specialized equipment may be used, since payoff requirements can be met in long runs of standardized items instead of short runs of "specials".

c) Fewer varieties of materials need to be stocked, so that the total inventory investment is cut down and losses from deterioration or changing market values are minimized through fast-moving inventories.

d) Work planning, production control, and other management procedures can be simplified and their frequency of repetition reduced.

e) Prompter and better service may be offered to customers in respect to original purchase and subsequent reorder, repair, part replacement, or performance under warranty.

To increase productivity along these lines, the in-plant standards activity must work towards the introduction of procedures that offer the greatest gains. This will consist mainly in a drive towards external standardization (i.e., national and international) and internal standardization through the guidance of company employees. Such efforts will require facilities for reconciling divergent opinions and for monitoring the standards so that they are consistent with industry practices as well as with internal procedures. In-plant standards should be such that they operate with the full support of the company management, on the basis that their cost is an investment that will be easily recouped through increased productivity and profits for the company.

The introduction of in-plant standardization into a developing country need not follow a pattern different from that which took place in the industrially developed countries, unless special circumstances make it necessary. The first three steps in starting

an in-plant standards programme are: reduction of item varieties; simplification of the product; and an approved charter for standardization. "Standardization" is not to be looked upon merely as a "simplification" process. Simplification should be a part of the coordinated programme for standardization. Another important point is to avoid starting work on certain problems just because they are easy, attractive, or have been brought up by individuals or groups requiring immediate solutions to their problems. An approved, planned aproach, starting with these three steps, will avoid digressions from the main objective and help to achieve the primary goals of standardization.

In-plant or company standardization provides cost reductions through the use of fewer raw materials, small parts inventories, lesser requirements for special machinery, reduced obsolescence in materials and equipment, more efficient use of man-hours by means of controlled production of standard parts, product simplification through interchangeability of parts, and fewer drawings. Additional advantages also occur if standardization is applied to in-plant operations on a continuing basis.

6. MAINTENANCE AND STANDARDIZATION

Increasing attention is given to the fostering of economic and industrial growth in developing countries through high investment ratio and through transfer of capital and technical know-how from industrialized countries. However, industrial development does not confine itself to investment in new production facilities. To achieve industrial growth, the installed facilities must be used efficiently. One of the prerequisites for the efficient use of equipment is systematic maintenance and repair.

Industrial surveys of developing countries show that the installed capacities are to a large extent poorly utilized. Admittedly, the reasons for low utilization of installed capacities can be bad project planning, low labour productivity, poor management, unfavourable general economic conditions, etc. But to a large degree the considerable downtime of machinery caused by breakdowns and stoppages contributes to the low utilization of capacity. Thus, poor maintenance and repair generally cause economic losses through lower efficiency of the installed machinery, lower quality of products, and higher costs of production. In addition, poor maintenance and repair lead to the deterioration and consequently shortening of the physical lifetime of installed machinery. This clearly is a significant waste of capital - the most scarce factor in developing countries. Owing to this squandering, industrial development in developing countries is hampered and burdened with greater obstacles and higher costs than would appear necessary. The increasing indebtedness of developing countries tends to aggravate the situation, since it puts serious financial limitations on the purchase of machinery, equipment, and material.

Improving maintenance and repair in developing countries would thus be one of the most important and effective ways of stimulating industrial development. With relatively small inputs considerable gains could be achieved both in the short run and, above all, in the long run.

Maintenance should not be thought of simply in terms of shop-floor activities, such as the tightening of a nut, lubrication of a bearing, or repairing of a machine part when it breaks. In fact, this limited approach is one of the main reasons for inadequate maintenance performance in developing countries. Therefore, it would be of little use to help developing countries to improve repair facilities or build up new ones without establishing an adequate maintenance management and stimulating maintenance mindedness at all levels. Managerial and economic aspects are of crucial importance in this field.

The objectives of maintenance are:

a) To extend the useful life of equipment. This is particularly important for developing countries in view of their lack of capital.

b) To assure the optimum availablity of installed equipment for production. Developing countries should aim at getting the maximum possible return from investment.

c) To ensure instant operational readiness of all equipment for emergency use, for example, stand-by units, rescue units, etc.

d) To ensure the safety of personnel.

The importance of standardization of equipment as a means of simplifying maintenance work should be emphasized. However, developing countries face difficulties in achieving a reasonable degree of standardization. For instance, a stipulation in bilateral assistance agreements that equipment is to be purchased from the donor country hinders standardization greatly. It is felt that the possibility of achieving international standardization of equipment intended for developing countries is very remote and that the solution to the problem of standardization lies within each developing country. This particular problem should receive due attention from standardization bodies.

PAPER 3.2 - THE INTERNATIONAL STANDARDS PICTURE

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Cleveland, Ohio

Rather than give you the usual talk about the virtues of standardization, the workings of ISO and IEC, and an accounting of their accomplishments and their ambitions, I intend to share with you some of the reflections and observations which I have gathered during a 20 year period of active front-line participation in international standards work. Before I go into it, I am going to say that some of my remarks may appear to be quite cynical. They are not intended to be offensive, and if you find them that way, I apologize. I am merely trying to relate to you, as honestly as I can, the realities of international standardization as it is being lived today, and hopefully to shed a little light on the motivations and conduct of some of the more highly industrialized countries. Perhaps I can identify for you the role of the less developed countries and suggest how their participation and involvement can and should be strengthened.

Let me first explain the boundaries within which I feel I have a certain qualification with which to speak. I have been associated with the fastener manufacturing industry in the United States for 28 years. Fasteners are bolts, screws, nuts, rivets, washers, and pins. They are the articles used to assemble every conceivable structure, vehicle, machine, piece of equipment, from the most sophisticated space missile to the simplest of children's toys. Fasteners are totally pervasive throughout our industrial life. In fact, it is difficult, if not impossible, to name a single industry that doesn't use mechanical fasteners in highly significant quantities.

Most countries of the world now manufacture fasteners. Because fasteners are highly standardized and are used in such fantastic numbers, the markets of the more industrialized countries have become very attractive to other countries that as yet may not be so highly industrialized, but nevertheless, have developed flourishing and expanding fastener manufacturing industries.

Internationally, there are two organizations active in standards work: the International Organization for Standardization (ISO) and the International Electrotechnical Commission (IEC). When ISO was first organized in 1947, the first two technical projects it authorized were on screw threads, TC-1, and fasteners, TC-2. Since 1958 I have been a delegate from the USA to most meetings of TC-1 and to *all* of the meetings of TC-2. Consequently, my remarks reflect primarily my association in the work of TC-1 and TC-2, especially during the past eight years, when we have tackled the extremely difficult and highly controversial task of negotiating the basics of a single system of engineering standards for mechanical fasteners.

There are a number of thoughts that I would like to discuss with you. Generally, they flow in the same pattern as that by which a standard is developed: the inception, the period of negotiation, acceptance, publication, and the aftermath.

Let's talk first about the different types of engineering standards. Standards covering such subjects as nomenclature, definitions, reference materials, and test methods, are reasonably easy to write and generally are non-controversial. Processes, manufacturing controls, mechanical and performance requirements, quality assurance levels, ratings -- these are considerably more difficult, but still there is plenty of room for give and take, and friendly accord is usually possible. And then we have product standards: documents which define sizes, shapes, dimensions, tolerances, and all of the other features which affect the interchangeability of manufactured parts. These are by far the most difficult to develop, because before true international interchangeability can be realized, one or more countries must accept physical changes in the products they are currently producing and using domestically.

Change is expensive. Change is disruptive. Consequently, when negotiating international product standards, the primary motivation is not always technical, but more often it is to minimize your country's costs at the expense of those of others. The great majority of the international fastener standards are product standards, and this has been the nub of our problem. While we all readily agree that we want and need international standards, the question is, "Who will make the sacrifice of change?"

Let's take a look now at the "why" of a standard. What's the incentive? Or, more crassly stated, what's in it for me? And this is a question that all countries, regardless of their industrial development, should ask.

We are all aware of the altruistic platitudes about trade expansion, exchange of technology, social responsibility of the haves to the have-nots, and they are all valid objectives, with no criticism intended or offered. But I suggest to you, that no country, nor any segment of its industry, should spend any time, effort, or money, on a standards project that doesn't offer a full and generous return on the needed investment. Standardization is a business function. It costs money, and if the pay-off doesn't justify the involvement, then don't do it!

With respect to fasteners, the work of TC-2 progresssed at a very lazy pace for 20 years, with only peripheral accomplishments. About ten years ago it became increasingly apparent that many of the multinational corporations of the world, all of them fastener users, for their own very good economic reasons, wanted a single system of engineering standards. They wanted to design, procure, assemble, market, and maintain all to one system, regardless of geographical location. Quite obviously, this one system had to be in metric. And frankly, this is the reason why the USA is now moving toward that system of measurement. This established the incentive, and the work of TC-1 and TC-2 accelerated dramatically.

The next question we might ask ourselves, is why do all of the highly industrialized countries take such an active role in international standards? Is it because they have a willingness to share their experience and their technical expertise, for the international betterment of all? I would like to think so, and I hope it is true. But I suspect it is more for the simple reason of self-preservation. Countries may come to the negotiating table professing cooperation and constructive intent, but they are all there to promote their own domestic practices. In effect, they are all trying to avoid the trauma and cost of change for their own industries and to foist if off onto the backs of others.

We now enter the important period of negotiation, and the actual structuring of technical content. First, any country hoping for even modest success, must be represented by qualified technical experts. They must be well-briefed, nimble thinkers, and willing to work hard to achieve their country's position. International standardization meetings are no place for tourists. Many times, I've seen defensible positions lost, unnecessarily, because of incompetent representation.

Continuity of representation is equally important. None of these meetings are easy. They generally move fast, and first time attendees without previous experience or background usually find themselves at a significant disadvantage.

During the initial exchanges, each spokesman presents articulate and compelling arguments why the national practice he expounds is technically superior and why the international standard should be written in its image. We are all guilty, and yet, why not? We genuinely believe in the correctness of our position because it is based on our own country's experience. It's life as it is being lived in our own country, and we know our own domestic producing and using industries have found it satisfactory. But, usually, when you scrape away all the oratory, and you take a hard look at the various approaches which have been proposed, they generally boil down to one thing: we are all saying, let's do it my way! Or, more crudely stated, let your industry suffer the expense and disruption of change, while mine continues business as usual!

After this type of opening exchange -- it's almost a ritual -- there is then serious and objective analysis of the technical merits of competing proposals. Rarely have we found one exclusively the best, but rather, the best answer is a combination of the better

features of each. One thing we have all learned, regardless of the degree of technical sophistication or industrialization of our own country, is that no single country, or even group of countries, has a monopoly on scientific or engineering brains.

To reach international accord, there must be concession, there must be compromise. And here is where participation by some of the less industrialized countries can be extremely helpful. While their industrial strength may not yet match that of others, this doesn't mean that their engineering talent is any less competent. Frequently, guidance from a third party can be invaluable in helping resolve points of impasse. Sometimes adversaries are so blinded by what they feel is the obvious correctness of their positions, that they cannot see the viewpoints of others. Let the role of the technical representatives of the less developed countries be to open eyes and ears and help soften the polarization of positions!

Unfortunately, however, playing the role of a technical adjudicator may indirectly create a difficult problem for such countries. And the reason is this: If an international standard is to gain acceptance, and more importantly, if it is going to be used, its contents must reflect the best technical practice of any of the participating countries. Any international standard presenting less than the level followed domestically in any participating country will not be adopted by that country. No country should be asked to down-grade its technical and industrial practices, just to be in accord internationally. In fact, even though a country's sympathies may lean toward international compromise, its own industry, and frequently its own laws, will prohibit such regression. This puts a severe burden on the less industrialized countries, because it requires them to meet the best, immediately, without the maturing processes that the more advanced countries have been permitted.

It has been suggested that international standards might establish varying levels of quality to encompass the manufacturing capabilities of different countries. Perhaps this is feasible in some industries and for some commodities, but for fasteners it is quite impractical.

The length of time needed to finalize international standards has often been criticized. Certainly, to many participating countries, it may seem ridiculously long, and there may be even some suspicion of deliberate obstruction. Those countries in which the producing and using industries are of fairly modest proportions, and those countries which conduct their standardization by governmental edict, must be somewhat mystified at times by the apparent floundering and maneuvering of the larger countries, particularly those of North America and Europe. Perhaps I can explain.

The reason is that most of these latter countries have voluntary consensus standards systems. This means that all interested parties have a voice, and that action cannot be taken without the support of a substantial majority. Quite often -- and believe me I've been through this more times than I like to remember -- it is much easier to reach a decision internationally, than it is to gain the endorsement of that decision after you return home. In the USA, major international decisions must be ratified by national committees. These committees are made up of representatives of all industries -- large and small, internationally oriented and exclusively domestic. All of these interests, and very properly so, view each international decision through their own parochial eyes, and their response frequently runs the gamut from enthusiastic support to active opposition.

Our own national standards procedures dictate that such differences must be resolved, if not into a unanimous position, at least into one that is a provable consensus. This takes time, and often results in a re-evaluation of national positions, with modified views presented at subsequent international meetings. I know this is trying on the patience of other countries, but we do need your understanding. If international standards are impatiently bullied through by majority voting, they risk not being adopted by important trading partners. And standards which are not used are totally wasteful of everyone's time and effort.

So finally we reach accord. We indicate our domestic intent to change as necessary to reflect the international decisions. We convince ourselves that a respectable technical job has been accomplished. We vote approval, and an international standard is published. And this introduces the last of the problems requiring some mutual understanding.

Many of the smaller countries are now adopting ISO standards directly, without any change, as their own national standards. For the less developed countries, this is sensible, it is the most economical approach, and it puts the country immediately into the mainstream of international agreement.

However, the highly industrialized countries all have their own systems of national standards and direct adoption of an ISO standard is impossible for most. The reason is that many ISO standards -- and again, I am thinking primarily of those for fasteners -- are incomplete, in that they present the basics, but not all of the specifics, required by industry. This necessitates publishing a national standard, which will include the content of the ISO standard, but which will be expanded to present additional information. The important fact is that these additional requirements will not affect the functional interchangeability of manufactured parts and should not be viewed as a rejection of international agreements, or as a unilateral effort to erect a trade barrier. Our national system, the industries we serve, and frequently our laws and Federal regulations, dictate this practice.

In conclusion, let me give you a quick update on where we stand in the development of international fastener standards. We've been through a very difficult and trying eight years. It's been eight years of controversy, and at times, very unpleasant confrontation. But the job is now done, and there will be a single system of engineering standards for mechanical fasteners. I think we are all well satisfied with the understandings we have reached. The system is technically sound, and it is provably superior to any that is now standard in any country of the world. For those of us who have been on the front line, it has been an enriching and maturing experience. There is still much to do, but we look forward optimistically to continuing that work. It should proceed smoothly and efficiently. All of us are looking forward to the active help of many more countries.

DISCUSSION:

Questioner:

Can you give us any idea of the cost to the United States to adapt to this new international standard?

Mr. Belford:

Our cost to go metric is going to be quite significant, and I don't think anybody could estimate a true value. If you are talking about what it is going to cost an industry such as ours to accept the international standards for metric fasteners, it will be reasonably nominal, simply because we have had no metric standards for fasteners. All of our production up to very recently has been in inch. Our goal throughout this entire exercise in ISO has been to help design an international system of metric fasteners, that we can accept and use with confidence that it is technically good and reflects a reduction of number of parts to the degree possible. We have tried to build in just as much economy and technical improvement as possible. For the Europeans, it is going to be expensive. For other countries of the world that are now metric, it is going to be expensive, simply because they have to make a number of significant changes in their manufacturing and use practices. But again, the incentive was there to have a truly international system. So when people accept that, then they swallow really hard and accept the change that comes about. They satisfy themselves that in time they'll have a better system, and it will be truly international.

Mr. David Edgerly (National Bureau of Standards):

You mentioned that it is difficult for an industrial country to accept or adopt an ISO standard in toto, that indeed you must go a bit further. Could you illuminate a little

bit, give me some examples of the type of additional things that are necessary?

Mr. Belford:

Let's take a hex nut. You are all familiar with a hexagon nut. It has a width across flats, it has a thickness, it has a thread tapped through the middle of it, and that's about it. However, a hex nut has about 24 separate elements or dimensional characteristics that can be toleranced, and should be toleranced, if there is going to be proper manufacturing control and for inspection acceptance by the customer. The ISO standard for a hex nut might cover 12-15 of those characteristics. The others have been historically toleranced in our own USA standards, and users who have been accustomed to this practice expect the tolerancing of these additional 8-9 characteristics in metric standards. As I say, they are very peripheral. They do not affect functional interchangeability in any way, but these are things that we just have to do. You could take almost any fastener product and find a similar situation.

Mr. Edgerly:

You don't think it appropriate that those additional requirements, including the test methods that would be necessary to ensure compliance with the standard, should be made part of the ISO standard as well?

Mr. Belford:

We would like very much that they would be. And we have suggested these things from time to time. But, other countries of the world feel these are unnecessary refinements, and consequently, we work on the basics and go as far as we can. Our position is very well known to the other countries, that when we publish an American National Standard for a product, it will include everything that has been agreed in ISO, but there may be some additions. We do our very best to qualify that we are not going to be disruptive of interchangeability of parts. Most of the time any product that is manufactured in other countries would find acceptance against these same requirements if it were inspected for them, but the other standards of other countries and the ISO standards do not require them. Unfortunately, in some respects (speaking as a producer), our standards do.

Mr. Albert Baron (United Nations):

Would you indicate how long it will take for the United States to move toward metric in the industrial fastener area?

Mr. Belford:

We are substantially metric now. I would say that in our producing industry in this country, perhaps 10-15% is now metric. And we are going toward metric just as fast as our customers wish. National standards for metric fasteners -- these are ANSI, ASTM and SAE standards -- based on the decisions that have been finalized in ISO, are well advanced in their writing, and a great number of them right now are going through the various procedures leading to their publication. By the end of 1979, the great majority of these standards should be in print. And, every year from now on, more and more of our production will be in metric.

Mr. Baron:

Do you have any idea when Detroit will have major motor cars with metric fittings?

Mr. Belford:

They do now, sir.

PAPER 3.3 - TOWARDS STANDARDIZATION IN GUYANA

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I. SUMMARY STATEMENT

Industrializing nations, wishing to put their economies on a sound base, must produce both for domestic consumption and for export. With respect to domestic consumption, industrializing nations should seek to establish without undue delay compulsory national standards for specific consumer products, which can potentially affect health and safety, particularly in the areas of food and drugs, and for those consumer products for which there is monopoly ownership. Voluntary standards should be set for products that are competitive, so that consumers can choose products that satisfy, if not all of their needs, at least most.

With respect to exports, industrializing nations must satisfy the requirements of trading partners, within their capability, so that standards for exports should be determined by mutual agreement between the parties concerned. These need not be international standards, since international standards are based on general consensus, part of which may in certain circumstances be disadvantageous to some exporting countries, and vice versa.

There should be international standard regulations governing the ethics of pricing agreements, whereby a lower ceiling remains intact, thereby providing a built-in safeguard for small developing nations. Sugar is a good example, where presently the world price is far less than production costs.

The existence of an international standards organization, for example the ISO with its present aims and objectives, is welcome. However, small developing nations are presently not in a position to derive benefits which may accrue from membership in this Organization, since the quantum of the membership fee, as it now is, is outside the financial ability of some small developing nations, in terms of GNP. Perhaps some nations may appreciate the proportioning of the ISO membership fee to GNP for each potential member nation.

A readily identifiable problem of small developing nations is the dire lack of hard currency to purchase hardware and software, and to develop much needed skilled personnel. This is a particularly serious problem, since manpower development is very, very slow. Lastly, I wish to comment that there seems to be an urgent need to revolutionize the teaching of science, so as to attract more students to the graduating classes at the secondary school and university levels, and to lift the levels of understanding and know-how of these potential scientists.

II. PREPARED PAPER

1. BACKGROUND

1.1 Geographical:

Guyana occupies an area of 215,000 square kilometres on the north coast of South America immediately east of Venezuela. Its climate is tropical with temperatures in the range 27-32°C and an average rainfall of 228 cm per annum. It encompasses four well defined geographical regions, viz., a low lying agricultural coastal plain supportive of rice and sugar; heavily forested hills of sand and clay encapsulating extensive resources of high grade bauxite and low grade iron ore; the auriferous highlands; and the lush cattle-raising savannahs. The population is estimated at about 800,000, 60% of which is under 25 years, with an annual increase rate of 2.5%.

1.2 Economic:

Agriculture has been identified as the main thrust of the development plan, and its activities are concentrated mainly on the coastal plain and certain parts of the riverine areas. The main crops are sugar and rice. Other activities are related to blackeye peas, soya beans, tilapia, ground provisions, peanuts, plantains, bananas, wheat, citrus fruit, fish, and cattle.

The shrimp resource off the north eastern coast of South America, including the 320 kilometre Guyana coastline, is the basis of a major international fishery industry.

Bauxite is the other major export commodity.

1.3 Scientific and Technological Indicators:

Of 35 organizations surveyed by the National Science Research Council, the following data[1] may serve as indicators of the present scientific-technological manpower capability:

Ph.D.	-	36
M.Sc.	-	47
Post Graduate Diploma	-	26
B.Sc.	-	173
Undergraduate Diploma	-	353
Non-scientific Diploma	-	81
Other	-	751

Government's instituted policy of free education from nursery to University should eventually raise the quanta of these indicators.

2. TOWARDS STANDARDIZATION

2.1 Legislative Proposals:

The formal introduction of standards and standardization in the society will, like most if not all new measures, be faced with some difficulties, in particular those generated by resistance to change. It is, therefore, necessary from the inception to have the stage well set to cope with this, firstly by clearly defining the functions, powers, and structure of the organization charged with the responsibility for effecting the system of standards and standardization, and secondly to acquire the necessary legal tools for facilitating specific functional activities. Hence a First Draft of a Guyana Standards Act has been prepared, making use of the experience of other societies by studying Standards Acts of eight countries.

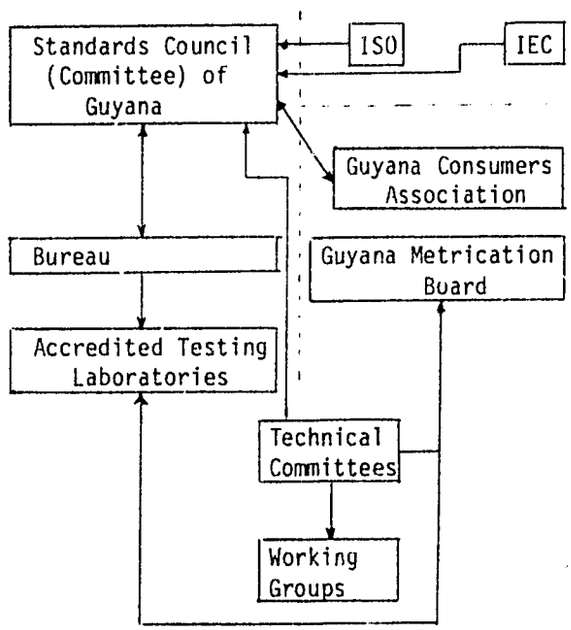
[1]The National Paper of Guyana--For the United Nations Conference on Science and Technology for Development.

After the enactment of the final version, at various times and as an on-going process, pertinent regulations dealing with standards specifications and codes of practice will be generated.

2.2 Essential Features of our Standards Organization:

The essential features of the proposed Guyana National Bureau of Standards are shown in Schematic 1.

Schematic 1. Overview of the National Standards System



2.2.1 Standards Council:

The Bureau shall be managed by a Standards Council which shall have power to:

(a) supervise and control the administration and financial mangement of the Bureau;

(b) advise and obtain advice from the Minister responsible for standards in regard to any matter within his purview under the Standards Act;

(c) formulate matters of policy for the purpose of providing general or specific

guidance to the Bureau for the better performance of its functions under the Act;

(d) do all things necessary for the better carrying out of the provisions and purposes of the Act except where otherwise provided.

Members of the Council shall have qualifications in fields relating to standards, or experience in business, or shall be members of organizations committed to the maintenance or promotion of standards. The Director of the Bureau shall be the Executive Secretary of the Council.

2.2.2 Technical Committee and Specialist Working Groups:

Since the Bureau cannot employ on a full-time/all-time basis a wide range of expertise, and since also consultation with a wide cross-section of informed opinion is essential, some of the work of the Bureau must be done through Technical Committees.

The Standards Council will from time to time appoint Technical Committees to draft or adapt specifications/codes of practice, consider comments thereon, and review specifications, and to recommend specifications to the Council for adoption as voluntary or compulsory standards. The Technical Committees will assign priorities to the preparation of specifications in the field in which they operate and will recommend to the Council the composition and terms of reference of Working-Groups. Technical Committees will be representative of a cross-section of knowledgeable people from manufacturers, researchers, marketers, distributors, and users.

The Technical Committees shall establish specialist Working-Groups as the need arises. Working-Groups shall comprise persons drawn from official and unofficial bodies with knowledge and experience in some of the following areas:

- Import and Export
- Industrial Production
- Retail Marketing
- Textiles
- Physics
- Chemistry
- Engineering and Architecture
- Mechanical Engineering
- Electrical Machines
- Standards Work
- Economics
- Consumer Education and Consumer Affairs

3. RELATIONSHIP WITH INTERNATIONAL AND LOCAL AGENCIES

The Bureau seeks to serve the manufacturer, industrialist, trader, salesman, and consumer and as such cannot operate in isolation. The Bureau will, therefore, relate meaningfully with the following, among others:

- o The International Organization for Standardization, ISO
- o The International Electrotechnical Commission, IEC
- o The Guyana Metrication Board
- o The Guyana Consumers Association
- o Accredited Testing Laboratories

3.1 International Organization for Standardization:

The Bureau sees much value in membership of the International Organization for Standardization for the following reasons:[2]

- ISO is the specialized international agency for standardization, comprising the national standards bodies of 81 countries;

- The ISO work covers a wide range of topics;

- The results of ISO technical work are published as International Standards, which represent a global consensus of opinion;

- In all, some 100,000 experts in different fields are involved in the ISO work.

[2] ISO - in brief - 1976-09-20

3.2 International Electrotechnical Commission:

IEC, as described - quote - "The members of the Commission are the National Committees, one for each country, which are required to be as representative as possible of all electrical interests in the country concerned: manufacturers, users, governmental authorities, teaching and professional bodies. They are composed of representatives of the various organizations which deal with questions of electrical standardization at the national level. Most of them are recognized and supported by their respective governments."[3] - should provide invaluable reference data.

3.3 The Guyana Metrication Board:

Guyana has initiated action for the establishment of a Bureau of Standards at a time that should allow standards and standardization to be more impactive on the national economy.

Standards underlie all mass-production methods and facilitate the integrating process necessary to large-scale production and distribution. This is more so since presently a *Metrication Board* has been established to coordinate and implement a programme for Metric Conversion from the Imperial System of Weights and Measures. Standardization and its concommitant Metrication will bring about the following:

- reduction of varietal production
- achievement of component/parts interchangeability
- reduction of stocks and enhanced inventory control.

[3] ISO MOMENTO 1976

3.4 The Guyana Consumers Association:

The Guyana Consumers Association has as objectives, *inter alia*, the following:[4]

(a) To improve the general standard of living through aspects relevant to consumer education;

(b) To represent consumers before public, industrial, commercial bodies and government agencies;

(c) To raise the hygienic conditions of production, improve processing, packaging, transportation, and marketing of food products;

(d) To improve hygienic conditions in all public places where food is sold and/or consumed and to raise the standard of presentation of food in all such places;

(e) To work with national standardizing bodies in developing methods of test for consumer goods;

(f) To provide consumers with information about frauds, rackets, false advertising, harmful products, shoddy goods, unsafe machines.

3.5 Accredited Testing Laboratories:

The establishment of laboratories for scientific and technological work is a costly exercise even without consideration of the accompanying cost of personnel development to operate them. The Bureau's laboratory work will therefore be done in a two-pronged mode; firstly, in Bureau Laboratories equipped with essential apparatus not now available in Guyana and for testing not done elsewhere locally, and secondly, in laboratories at the University of Guyana, the Government Analyst Department, the Guyana Sugar Corporation, the Guyana Mining Enterprise, and Government Departments, should these be accredited for the Bureau's work. For the latter case the following observations and proposals are made:

[4] extracted from 'Constitution of the Guyana Consumers Association'

Observations:

Advantages:

(a) existing laboratories and equipment

(b) existing personnel experienced in the use of (a)

(c) existing maintenance support

(d) maximal utilization of resources

Disadvantages:

(e) conflicts in actual work scheduling

(f) the problem of accountability

Proposals:

(a) that the proposed use of these existing facilities be taken up at the highest possible level--probably Ministerial, so that obstacles to progress in implementation may be minimized or eliminated;

(b) that a feasible fee structure be developed to defray the cost of equipment maintenance.

4. THE LIBRARY

The Library will be the first permanent facility to be established in the Bureau for the following reasons:

(i) For the period up until December 31st, 1978, the Bureau has no hard currency and is without a budget.

(ii) The Bureau has one full-time functionary in its employ.

(iii) The only material facilities in the Bureau's possession are standards literature.

Note: (a) The United States Agency for International Development has donated 3,500 volumes of standards.

(b) The Indian Standards Institution of New Delhi, India has donated 9,000 volumes of standards;

(c) The Guyana Sugar Corporation has donated G$5,000 to aid the establishment of the Standards Library;

(d) The Guyana Mining Enterprise has committed itself, in principle, to further assist in the establishment of the Standards Library.

A Catalogue of the Standards Literature is being prepared for distribution. The back-cover will carry a reply card which will record information about recipients' needs and interests, which on return will augment the Bureau's information base, a necessary tool for intelligent planning. It is hoped that even before national standards are generated and laboratories are installed, that study and implementation of information on hand will directly better product quality.

5. ADMINISTRATION AND OPERATIONS

5.1 Organization:

To facilitate smooth functioning through understanding, the following guidelines have been prepared:

(1) Guidelines for Chairpersons of committees/working-groups

(2) Guidelines for Secretaries of committees/working-groups

(3) Guidelines for Members of committees/working-groups

(4) Guidelines for the preparation of draft standards.

Since metrication is imminent, all members serving the Bureau as permanent staff or in committees/working-groups will soon be exposed to a viewing of Metric Films available in Guyana.

5.2 The Public:

The Bureau will inform and educate the public about its existence and its *modus operandi*. Public awareness of the role of standardization is likely to be slow. It is hoped to accelerate this by launching an awareness programme commencing with the showing of two films, viz:

(a) Standards are for Living -- made by the Standards Council of Canada;

(b) Standards for a Better Life -- available at ISO.

This would be followed by a programme of publications, mass media excerpts, training courses, lectures, exhibitions, and career guidance sessions at colleges and schools, tailored to suit each target audience.

The program content shall be concerned with:

- Standard Specifications
- Standard Test Methods
- Standard Codes of Practice
- Inspection
- Enforcement
- Quality Control
- Certification

Quality Control will be directed to three categories of people--Manufacturers, Salespersons, and Consumers.

The Manufacturers will be made conscious of their products' entire industrial cycles, and will be exposed to aspects of:

(1) raw material control

(2) process control

(3) cleanliness of materials used for packaging

(4) finished product inspection

(5) information and care labeling

(6) product transportation

(7) quality costs which would include:

(a) prevention costs

(b) appraisal costs

(c) internal failure costs

(d) external failure costs;

since it is envisaged that these would enable them to attain increased effectiveness and lower overall quality costs.

The Salespersons cannot be omitted in this exercise and will be exposed to topics concerned with hoarding and product deterioration and the effect of fraudulent practices on product quality.

The Consumers will be advised on matters concerned with:

(1) how to buy;

(2) 'use' and 'misuse' of commodities;

(3) general information which will minimize the tendency for the general public to associate faults in manufactured products and commodities with the efficiency of the National Bureau; and

(4) certification, which will give the consumer the technical help he/she needs for judging the quality of a product.

5.3 Staff Recruitment:

As a direct input into expanding and enhancing the manpower recruitment pool, the Bureau can equip itself to organize the teaching of a programme on standards and standardization at two levels -- University and Technical Institutes.

5.4 Personnel Development:

Personnel development should be done in several ways operating in harmony, viz:

In-house Training -- Plans are afoot to use the services of experts deputed from the Indian Standards Institution, New Delhi, to conduct a course in Standards and Standardization locally in June to August of '79.

Production Enterprises -- Discussions will be held with production enterprises with a view to arranging on-the-job stints for Bureau staff.

International Forums -- Provisions will be made for staff to benefit from international exposure through attendance at seminars, workshops, conferences, and training attachments.

5.5 Development of a National Standard and its Application:

Preparation of a Guyana National Standard shall be undertaken in response to a request from any reasonable source -- a government department, either as a statutory authority or as a user, a consumer organization, a trade or other association or an individual firm -- provided that full inquiry yields evidence that the project is generally endorsed by the interests concerned and that these interests will cooperate in the drafting work.

5.6 Application:

(1) The Guyana National Bureau of Standards specifications, test methods and codes should gain recognition as National Standards from the fact that they are prepared and accepted by all interested parties represented on the drafting committees. Generally they should derive authority from voluntary adoption based on their intrinsic merit.

(2) Where a standard is concerned with matters affecting safety of life or property, and where there is no competition in a specific area providing an avenue for 'monopolistic exploitation', it may find compulsory application through reference in statutory regulations.

(3) The producer voluntarily adopts a standard by simple decision to comply with a relevant standard.

(4) The purchaser gives a citation of standard specifications as a condition of tendering and contract.

(5) Standard specifications may be applied through the use of a Guyana Standards Mark.

5.7 Certification and the Guyana Standards Mark:

The GNBS will own this Mark which will be registered as a certification trademark under the Trademarks Act. It shall be available, under license, to manufacturers who satisfy the Bureau that their products comply with appropriate published Guyana Standards and who are prepared to enter into agreements which shall include observance of general rules and of specific supervision and control requirements. These agreements shall bear the Bureau's seal, and non-compliance will result in license suspension.

6. COOPERATIVE AGREEMENTS WITH OTHER AGENCIES

Funding Proposals:

The GNBS will operate on a non-profit basis.

Income may be generated by:

A. 1. A Guyana Government Grant;

2. Annual contributions from:

- The Guyana Manufacturers Association
- The Consultative Association of Guyanese Industry Ltd.
- The Berbice Chamber of Commerce
- The Georgetown Chamber of Commerce

- All Public Corporations

3. Sales of Publications;

4. Fees from subscribing members not named in 2.

B. 1. GNBS can run courses for a fee for the staff of manufacturers, small industries, etc.

2. GNBS may charge fees for laboratory tests.

3. GNBS may acquire monies by way of penalties dictated in the Standards Act.

The Bureau will seek assistance from UNIDO.

7. STANDARDS AND THE FUTURE

GNBS work will be intimately related to Guyana's economic development. Each new area of production and each technological development creates a demand for new or revised standards. The removal of impediments to trade, nationally and internationally, the effective communication of technical information, the change to the metric system, spell out the need for continuing growth in both the scope and competence of the GNBS.

8. RECOMMENDATIONS

A. 1. That standardization be accepted as a precondition for both technological and economic planning.

2. That standardization be considered for rationalization of imports of capital goods.

3. That standardization be a prerequisite for simplification of spare parts stocking and inventory management.

4. That one-man (woman) business should be *discouraged* and cooperatives[4] be urged.

Reasons:

(a) too great a variety of production methodologies which would greatly 'strain' the resources of even a competent Bureau; standardization enforcement would be nigh impossible;

(b) too wide a range of raw materials;

(c) opportunity for fraudulent practices in food production.

5. That innovative steps be taken in education policy specifically to generate substantially larger numbers of students in science and technology both at the University of Guyana and the Technical Institutes by:

(a) Shunting a major allotment of potential students for the Social Sciences and the Arts at the University of Guyana to the Science and Technology faculties; the basic intelligence is there, the challenge is for the Lecturers to take up.

(b) Popularizing science and technology by radio and regular news media columns with emphasis on bringing about a change in attitude towards the use of science and technology in the development process.

6. That retired scientists and technologists who are able and willing to function be given the opportunity to be re-employed. (In some developing countries, scientists of 70-odd years are active.)

[4] The cooperative concept involves groups of people who come together as parts of a legal entity to ensure for themselves and the nation a better quality of life. Inherent in cooperatives is a new order of collective ownership, control, and distribution of wealth by people who are, themselves, users and consumers. The spirit of cooperativism is part of the historical and psychological make-up of Guyana. Our folklore contains compelling inspiration for cooperativism in the proverbs "One hand cyan't clap" and "One hand cyan catch louse."

7. That a distinction be made between Rural National Standards and Urban National Standards in view of the need to relate rural production to rural technology and to maintain community development in step with a progressive cultural outlook.

8. That the Commonwealth Science Council should explore the possibility of convening a Metrication cum Metrology Conference, treated dichotomously, in the Caribbean and not solely in Asia/Pacific countries, in order that the Caribbean may benefit from proposals for collaborative undertakings and share in certain calibration facilities and high-capital-cost testing equipment.

DISCUSSION:

Professor David S. Lieberman:

I think one should very early separate science and technology, the one having supposedly no avowed purpose, and therefore being capable of discovering new things, since it is not controlled in any way, and the other having the purpose of having to satisfy social problems in a given country. I think it is very important that the scientists and engineers be taught somewhat differently, even at the undergraduate level, and not be allowed to think that they are all scientists.

Mr. Hamilton Herman:

It would seem to me that in response to the problem of coming up with the highly trained, skilled people for the standards functions, that this is one of the areas where some of the regional laboratories can be most useful, because now you can pool your funds and your technical facilities. Is there some hope that you could use a regional approach in meeting these needs?

Mrs. Lawrence:

I do not know how much hope there is in that respect. There is a regional body in the Caribbean area, but that body is not in a position to give the kind of assistance that Guyana presently needs. Basically, what they do is pull together inputs from the various CARICOM members, and seek to harmonize the standards that exist at the particular time.

Mr. Owino-Okwero (Kenya Bureau of Standards):

I think that what you said about regional cooperation is very significant, but from my experience of Black Africa, the politics are too dynamic for this sort of cooperation. We have had an experience in East Africa when we had a regional standards organization, that didn't last a year. We worked all the time night and day to establish it, only when we got it set up, it got broken. So these are some of the problems. We hope that we can surmount them soon.

Mr. Hamilton Herman:

Most of the time, if you have some regional cooperation, all those people who are cooperating would be almost in the same boat, all need some help. So sometimes you have to go somewhere else.

Comment from floor:

You also have the problem of economies of scale, that unless you have some minimum funding you cannot have basic industrial development. So that if you are a smaller country, it would seem that regional cooperation is your only hope.

Dr. Al-Khalaf:

I think any cooperation between any two countries is much better than doing it individually, there is no question about it. Cooperation, I think, is very important.

Mr. Baron:

It seems to me that for many of the smaller countries, in fact, the problems of foreign exchange, of importing know-how, of skilled people are really very difficult. It seems to me in this connection there are really opportunities for technical cooperation among the developing countries themselves, as was brought out in the conference in Buenos Aires last summer. I think that increasingly we need to look at the possibilities of technical cooperation and assistance from the developing world to the developing world.

PAPER 3.4 - STANDARDIZATION IN PANAMA

Ing. Maricela Ferrer de Chan, Director
Comision Panamena de Normas Industriales y Tecnicas
Ministry of Trade and Industries
Panama City, Republic of Panama

Panama is located in Central America, with a population of 1.7 million inhabitants and 75,000 square kilometers. The history of our country is very recent. With the obtaining of independence from Colombia in 1903, and both before and after, our economic orientation was toward trade and commerce, because our main resource is our geographical position.

After the second war, in 1950, development began. Until now, we can say that we have not developed industry in general very much. A lot of effort is going on within the government, more than ever, to help the best growing of industry. It is significant to know the relationships between the producers of knowledge, such as the universities, the government, and the productive sector. I am going to try now to identify each sector with its main characteristics.

The producers of knowledge: We have two universities, one public and one private (Catholic). At the public university we have now 32,000 students in different fields. Little research is done, because the professors at that level are primarily occupied with teaching, and what they do in research is more of the type that they give to the students for theses. Only in medicine and other limited areas is serious research done. There exists some relationship between some industrial sectors -- for example, food and engineering -- and the university, through the services that the university does for them.

The productive sector is characterized by high speed machines, that can in some cases be working at 40% of capacity. That is not appropriate for a country which needs to use more manpower efficiently. Some of the industry is producing through license agreements and do not do any research, because this is done at the main plants abroad.

On the government side, as the result of a proposal of the Panamanian Society of Engineering, an industrial syndicate, and the University of Panama, there was created the Panamanian Standards Commission. The Comision Panamena de Normas Industriales y Tecnicas-COPANIT was established by the Cabinet Decree No. 282 of August 13, 1970, as an appointed organization of the Ministry of Trade and Industries, and, through coordination of the Department of Standards within the General Administration of Industries. At that time, the scope of this department was to study, elaborate, modify, and propose before the Ministry of Trade and Industries, the adoption of technical standards for the Republic of Panama. Likewise the Department was in charge of the establishment of the necessary technical commissions, designated to achieve the objectives mentioned above, in every one of corresponding industrial and technical branches.

At the present time, COPANIT has enlarged its objectives to include the quality control and metrology areas (conversion to the International System of Measurements - SI). However, attention is directed here to the technical standardization section.

It was not until 1971 that this Department began its task of standardization completely. Since then, up to this time, COPANIT has issued 236 Panamanian official standards, of which 50% have been realized during the more recent years. This fact is a distinctive sign of the growing conscientiousness among the groups that participate in the process of standardization. Actually, this section is working in 13 different areas of science and technology. It is hoped that the involved sectors continue their best working action of mutual cooperation in order to enable this department to end the year with the presentation of 55 documents properly polished and officially approved.

Technical standards are submitted for review and adoption to the following hierarchical order: Technical Committee of Director of COPANIT, Panamanian Standards Commission, and the Minister of Trade and Industry. The priority of efforts is established by means of consultations with all representative sectors of the country for the purpose of determining the topics of standardization for which importance and need justify inclusion in the program. The topics included in the program support objectives previously determined by aspects of the industrial, economic, and social development of this country. Furthermore, the topics follow a logical sequence in such a way that the study of the standards concerning raw materials, testing methods, and general classifications permits a rational approach to quality standards or product standards.

The integration of the work of the technical committees must offer a satisfactory balance among the interests of the following groups or sectors:

Production: Corresponding to the industries and enterprises that can be listed for the group of goods; producers, directly or indirectly.

Consumption: Corresponding to the consumer or distributor entities and those persons, whether natural or juridical, who can be classified in the category of goods and services consumers.

General Interest: Corresponding to the entities and persons, for which the nature of their activities can be considered unrelated to self-interest within the process of study of the standards: research institutions, technological institutions, etc.

For the purpose of providing national standardization with an efficient team capable of managing the operations performed in this field, COPANIT has participated in the following training activities:

a) "Water Bodies Pollution Control", at the Central American level (Panama).

b) "First Central American Course about Public Administration and Environmental Protection" (Costa Rica).

c) "Training in Technical Standardization, at Departmental Level" (Colombia).

d) "Third Pan American Course in Integral Standardization" (Mexico).

e) "Regional Composite Conference FAO/OMS about Food Standards for Latin America (Mexico).

In this year a new organization was created, the National Commission of Science and Technology, with the purpose of the establishment of the goal of the policies for science and technology in the Republic of Panama, in agreement with the National Development Plan. In 1972, the University was created a center for development of the national scientific capacity, with the objective of doing more research and retaining trained scientists in the country. All of these entities will work together in the new Science and Technological Commission, and I hope the coordination between all of them will work well.

PAPER 3.5 - STANDARDIZATION AS SEEN IN TANZANIA

T. Rajaraman
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I. TBS CONTRIBUTION TO THE PREPARATORY ACTIVITIES OF THE TANZANIA NATIONAL SCIENTIFIC RESEARCH COUNCIL FOR THE UN CONFERENCE ON SCIENCE AND TECHNOLOGY FOR DEVELOPMENT 1979

1. SCIENCE AND TECHNOLOGY FOR DEVELOPMENT

1.1 The Choice and Transfer of Technology for Development

Standardization is one of the basic components which any infrastructure must include in order to develop a sound economy. A well-planned standardization programme is the foundation on which to build up the store of knowledge which a country needs in order to be able to assimilate imported technology and utilize its own potential. It is a prerequisite for improving domestic quality and, hence, for becoming competitive on the world market.

(This was the philosophy behind the initiation of standardization activities in Tanzania. The Tanzanian Bureau of Standards was established under an Act of Parliament, which was modeled against a model law prepared by ISO to have a systems approach for national standardization work in developing countries. This bill assigns responsibilities for preparation of documentary standards, certification (both internal and external), and metrology services. The work has just been initiated, and we hope that it will have a good start in the near future.)

Standardization is understood to be the activity of establishing and applying technical rules in the form of standards. Standardization means, of course, the issuing of rules for the manufacture and use of products and processes but must be understood in its broad sense: standards cover scientific principles, terminology, specifications of products and methods, methods of test and, even more important, rules for the safety and protection of mankind.

In the category of scientific principles, there are standards which give basic data and conventions for use in mathematics, physics, and chemistry. Examples are mathematical symbols, physical quantities, units of measurement, and statistical methods.

The heading "terminology" covers not only definitions of concepts with the corresponding terms, but also the harmonization of symbols in different fields. Standardization includes the establishment of artifical languages: programming languages for data processing. The role of standardization in achieving worldwide understanding can never be over-emphasized: without consistency of technical language, transfer of technology is impossible.

Specifications of products and methods primarily concern the "traditional" fields: building construction, electrical engineering, and mechanical engineering. However, they also include medical research methods, highway markings, documentary methods, office organization (e.g., paper sizes). Hence, standardization extends far beyond the purely industrial areas.

Before a characteristic, such as stiffness in bending, can be specified, the method of testing the characteristic must be known. For purposes of quality assurance, it is essential to have uniform test methods. The basic importance of quality control has been recognized by the developing nations, and standards are a prerequisite for quality control.

Safety aspects must not be overlooked when product quality is being assessed. Governments are looking more and more closely into the question of ensuring personal safety, and safety standards set out the necessary precautions to be taken in order to achieve this. Other standards are concerned with protection from environmental hazards or take knowledge of ergonomics into account.

Thus it can be seen that standards broadly reflect the state-of-the-art. By making use of existing technical data, standards find common solutions to recurring problems and consequently avoid waste in both materials and manpower. They lead to compatibility of industrial practices in the different countries.

1.2 Elimination of Obstacles to the Better Utilization of Knowledge and Capabilities in Science and Technology for the Development of All Countries, particulary for their use in developing countries

Although standardization forms only a part of the overall technical activity, as can be seen from the foregoing, it plays a vital role in sophisticated technology. In industrialized countries, the beginnings of modern standardization go back about a hundred years (metre convention, standard time zones).

In Tanzania, standardization activities have just commenced with the establishment of the Tanzania Bureau of Standards under an Act of the Parliament. The technical work has been divided nto the following sectors:

i. Agriculture and Food
ii. Building and Construction
iii. Chemicals
iv. Mechanical and Electrical
v. Textiles

The technical committees have identified priorities for standardization and it is hoped that several standards will be published within a year.

It is, however, especially important to promote international standardization so as to eliminate obstacles to a better use of knowledge and competence in science and technology. TBS proposes to enroll itself as a member of ISO.

International standards operate as a vehicle for the transfer of technology. The active participation and interest shown by over 80 countries in ISO and IEC activities indicate that International standards represent an international consensus for the optimum solutions to problems related to standardization. The existence of International standards makes it possible for a standards body in a developing country to get round the problem of making the difficult political choice of which country's standards to take as the basis for its own national standardization. As a matter of fact, until recently national standards were the only means whereby the standards technology of developed countries could be transferred to the developing countries. The tremendous growth of international standardization means that the developing countries, like the developed countries, can use the work of ISO and IEC more and more to meet their needs for standards.

It has been estimated that only 2% of the world's scientific and technical resources comes from developing countries. At the same time, the developing countries are endeavouring to lessen their technological dependence on the industrialized countries and to stem the present outflow of money for the acquisition of technology. By comparison, International Standards are readily available to developing countries and involve only a minor outflow of money.

2. INSTITUTIONAL ARRANGEMENTS AND NEW FORMS OF INTERNATIONAL COOPERATION IN THE APPLICATION OF SCIENCE AND TECHNOLOGY

2.1 The Building Up and Expansion of Institutional Systems in Developing Countries for Science and Technology

Suitable institutional mechanisms for the preparation and adoption of standards in less-developed countries and a well-planned standards programme are important components of the infrastructure and are prerequisites for a successful transfer of technology from industrialized countries to developing countries. The national standards body plays a decisive role in the systematic development of the national economy and should be included in the planning work at the earliest possible point in time. It is further desirable for the national standards body to have the power to act in a coordinating capacity as regards standards work and technical regulation for the overall economy. A lack of coordination in the early stages of a country's development may have adverse consequences which will later be difficult to overcome.

It is also highly desirable to ensure participation in international standards work at an early stage of development. There are, for example, many international standards published by ISO (especially basic standards concerning quantities, units, symbols, technical drawings, tolerances, terminology, or the large number of standard methods of test) which are not dependent on any given level of technical development and can be taken over directly as national standards by the developing countries. This means that the standards institute of a developing country can begin with a collection of basic national standards without going through the long, arduous process of setting up and maintaining committees to publish standards on these subjects. Nevertheless, it is important for the national standards body to have the possibility of influencing the choice of subjects and the direction taken by international standardization and to ensure that its needs are fully taken into account during the preparation of international standards.

Finally, it is advisable for the national standards body to be responsible not only for the preparation of standards but also for monitoring and supporting their application. In developed countries, the application of standards can usually be left to the manufacturers: they have qualified technical staff who are able to ensure that production is in accordance with the existing standards, and they have the necessary experience and know-how at their disposal to be able to exercise quality control without assistance from the outside. In a developing country, the national standards institute can play an important role in the promotion of exports by working out suitable national standards and setting up a system of product control and marking which promotes compliance with these standards and quality goods for export.

As far as the country which I represent, Tanzania, the government is very well conscious of the importance of standardization, and is giving very good support for its program of work. Funding is not a problem for us. We hope that standardization will play a very important role in the development of the economy.

II. STANDARDIZATION IN TANZANIA

1. INTRODUCTION

Standardization is a recent factor in development of the economy of Tanzania. Basically, the economy of Tanzania is agricultural with the commercial and manufacturing sectors being second and third in importance. However, the industrial branch of the economy is presently registering the highest rate of growth.

Although the need for standardization has been felt for a long time, a real effort to introduce standardization and quality control in the national economy was made only about three years ago, when the government set up the Tanzania Bureau of Standards (TBS) under an Act of Parliament (Act No. 3 of 1975), and standardization was included as infrastructure for development of industry in the Five Year Development Plan. TBS was created as parastatal organization and is fully financed by the government.

2. AIMS AND OBJECTIVES

A principal aim of the TBS standardization programme is to meet the national interest by the stimulus it imparts to industrial development. Such an activity, in the main, involves the preparation and enforcement of relevant national standards in the different industrial branches and the gradual establishment of a guide to nationally agreed industrial practice which will render production units economical, enhance outputs of reliable quality levels, and foster import substitution.

The national standardization programme equally aims to protect the consumer's interest by virtue of this order and the benefits it introduces into national production and commerce as regards both locally produced items and imported goods. The programme also concerns itself with health aspects, safety requirements, and codes of practice.

Another important objective of TBS is to promote the country's export items, which are mainly primary products, by defining and certifying their quality levels. Through such an exercise the country will be in a

favourable position of gaining powerful sales arguments in international markets.

A still further major and important objective of TBS is to facilitate commerce and the orderly transaction of goods as well as to provide calibration services to industries through its broad national metrology programme which is linked with the TBS standardization activity.

Finally, as one looks into the future, one sees vividly that the conservation of scarce available resources and the attainment of an optimum overall economy are the far-reaching aims of a national standardization programme. In this context, therefore, the need to constantly widen the field of application and promote the rate of development of the standardization activity makes the national standardization programme a dynamic process. Moreover, such a national effort needs to be coordinated with multinational and international concerns and requirements in order to further achieve the aims underlying the national interest.

Moreover, standardization tasks are interdependent and, in fact, each is a prerequisite of the other, thus rendering isolated standardization efforts quite futile. Hence, precise defining of standardization tasks, better correlation of such tasks with national objectives and economic needs, and proper coordination or harmonization of task levels are all necessary in order to effect a meaningful standardization programme.

3. ORGANIZATION AND WORK PROCEDURE

TBS is a parastatal body. It has two main organs -- the Executive Council and a permanent secretariat headed by the Director.

The Executive Council, which consists of representatives from the concerned ministries, university, industry, etc., and whose members are appointed by the Minister for Industries, is the governing and policy making organ of TBS and as such approves all draft standards, the annual programme of work, and the budget of TBS. The Director, assisted by the Technical Manager and Executive Secretary, is responsible for the conduct of activities of TBS.

The technical work is carried out at present through five divisional standards committees, namely:

a) Agriculture and Food.
b) Chemicals.
c) Building and Construction.
d) Mechanical and Electrical.
e) Textiles.

These divisional committees have a number of technical committees, and all of them are fully representative of manufacturers, users, research bodies, technical experts, etc. Such technical committees are established for individual economic and industrial fields by the decision of divisional standards committees upon recommendation by the Director.

The work procedure of TBS concerning the preparation and issuance of Tanzania Standards (TZS) follows the universal "consensus method" practiced nationally and internationally. General surveys and investigations are initially conducted by the TBS secretariat for inclusion in the programme of work.

4. PROBLEMS AND PROSPECTS

A major problem area concerning the investigation of standardization needs and the preparation of the work programme is the fact that the needs are vast and pressing for the young TBS.

Consequently, the establishment of priorities and the task of planning ahead become real difficulties. TBS needs to make break-throughs in different fronts and fields of standardization, yet the limited resources which TBS commands, the time factor itself, and the lack of pertinent technical information and data are limiting factors. Moreover, the availability of only a few technical experts representing industry groups, research bodies, user interests, etc., limits the creation of specialized technical committees, consequently the committee structure is overburdened and the work is either prolonged or insufficiently considered.

The validity and suitability of existing work procedures and methodology need to be, therefore, questioned if not reviewed in the light of standardization requirements at the different levels and stages of development. The possibility of reinforcing the prevailing methodology by integrating the administrative and research approach with the consensus method of preparing standards needs to be explored, depending on the type and level of development of the national standardization programme. The balance can always be maintained at the point which the situation demands, the criterion being the need to produce usable standards in time.

5. MEASUREMENT SYSTEMS

The pattern of organization of precision measurement facilities in Tanzania is more or less the same as that found in many developing countries. In these countries, there is no single body which is responsible for precision measurement. In other words the National Measurement Standards Laboratory does not exist. The body responsible for "weights and measures" has its principal standards directly verified by the International Bureau of Weights and Measures or by a foreign National Measurements Standards Laboratory. The subsidiary companies (of foreign based firms) can still have their equipment, gauges, etc., supplied and verified through the parent companies, and their standards are, therefore, traceable to international standards through foreign National Measurement Standard Laboratories.

Local companies, research institutes, universities, and government laboratories are not so fortunate. While it is true that the imported measuring equipment of these organizations is traceable to international standards at the time of purchase, by virtue of the fact that the instrument suppliers can trace their standards back to international standards, it is, however, obvious that a gap exists between a local company, research institute, university, or government laboratory, and its respective instrument suppliers. Though the initial calibrations can be traced to the suppliers at the time of purchase, these organizations do not maintain these links to the international standards because they do not submit their equipment for recalibration. Many of the companies and institutes which do not have calibrations updated, recognize the need for recalibration; but because the amount of money made available for maintenance is so small, they cannot afford to meet the costs involved in transporting the equipment to a foreign National Measurement Standards Laboratory or the test fees involved.

The standard of measurement and testing facilities, and therefore of facilities for good quality control, varies widely among the developing countries, Tanzania being no exception. In Tanzania, facilities are very elementary indeed, and quite inadequate to support even a modest industrial development. In view of this, special emphasis was placed on establishment of a metrology set-up within TBS.

6. CONCLUSION

TBS has made a modest beginning and five divisional standards committees have started functioning. Several priority areas have been identified, and the work of formulation of standards on products for mass consumption, such as aerosol insecticides, mosquito coils, animal feeds, edible oils, soaps and detergents, etc., are in progress.

A plan for building a complex for testing and metrology laboratories and offices of the Bureau has been finalized and the Swedish International Development Agency (SIDA) has kindly agreed to fund the programme. Further assistance from international agencies such as USAID and UNDP are being explored for future expansion of the infrastructure in terms of testing facilities and manpower to meet the aspirations of the country for self-reliance and a reasonable view of quality in products and services provided.

PAPER 3.6 - VIEWS ON STANDARDIZATION

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I. THE KENYA BUREAU OF STANDARDS, AND ITS BUILDING AND CONSTRUCTION SECTION

1. INTRODUCTION

The Kenya Bureau of Standards (herein referred to as "KEBS") was established by an Act of Parliament called the Standards Act, 1973, - No. 17 of 1973. The date of assent is 16th January, 1974, and date of commencement is 25th January, 1974.

The Standards Act is arranged into the following Sections and Parts:-

Part 1 - Preliminary.
- 1.1 Short title and commencement.
- 1.2 Interpretation.

Part 2 - The Kenya Bureau of Standards.
- 2.1 Establishment of the Bureau.
- 2.2 Functions of the Bureau.
- 2.3 Director and staff of the Bureau.
- 2.4 The National Standards Council.
- 2.5 Powers of the Council.
- 2.6 Financial provisions.

Part 3 - Establishment of standards.
- 3.1 Standardization marks.
- 3.2 Compulsory standard specifications.
- 3.3 Appeals.

Part 4 - Enforcement.
- 4.1 Samples and information.
- 4.2 Appointment of inspectors.
- 4.3 Powers of inspectors.
- 4.4 Obstruction.
- 4.5 General provisions.

Part 5 - Miscellaneous.
- 5.1 Protection of Government, Institute, Council and members and employees.
- 5.2 Secrecy of information.
- 5.3 Victimization.
- 5.4 Regulations.

2. FUNCTIONS OF THE BUREAU (KEBS)

(a) To promote standardization in industry and commerce.

(b) To make arrangements or provide facilities for the testing and calibration of precision instruments, gauges, and scientific apparatus, for the determination of their degree of accuracy by comparison with standards approved by the Minister on the recommendation of the Council, and for the issue of certificates in regard thereto.

(c) To make arrangements or provide facilities for the examination and testing of commodities and any material or substance from or with which and the manner in which they may be manufactured, produced or processed or treated.

(d) To control, in accordance with the provisions of this Act, the use of standardization marks and distinctive marks.

(e) To prepare, frame, modify, or amend specifications and codes of practice.

(f) To encourage or undertake educational work in connection with standardization.

(g) To assist the Government or any local authority or other public body or any other person in the preparation and framing of any specifications or codes of practice.

(h) To provide for cooperation with the Government or the representatives of any industry or with any local authority or other public body or any other person, with a view to securing the adoption and practical application of standards.

(i) To provide for the testing at the request of the Minister and on behalf of the Government, of locally manufactured and imported commodities with a view to determine whether such commodities comply with the provisions of this Act or any other law dealing with standards of quality or description.

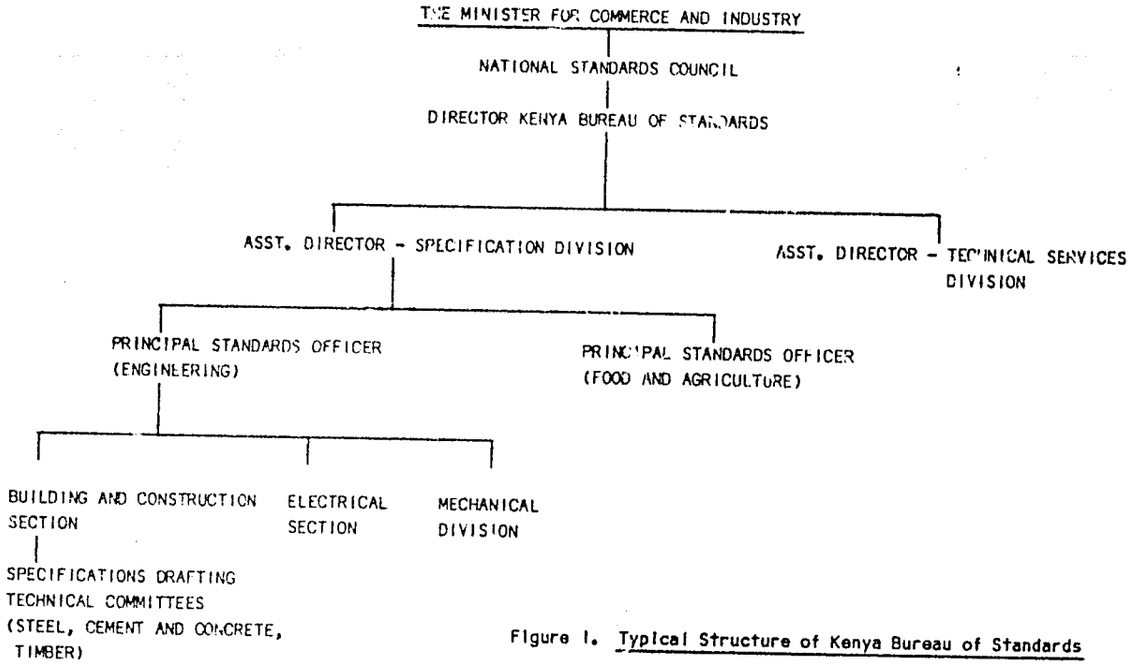

Figure 1. Typical Structure of Kenya Bureau of Standards

3. THE BUILDING AND CONSTRUCTION SECTION

Since the section became fully operational in May 1975, it has established three major Technical Committees in operation--namely, Timber, Cement and Concrete, and Steel Technical Committees. The emphasis was on basic materials, since a lot of these are from natural sources and influence very much the design principles.

The standards already covered are as follows:

(a) Timber:
- (i) Specification on sawn timber.
- (ii) Nomenclature of commercial timber of Kenya.

(b) Steel:
- (i) Specification on steels for building and construction - The standard details the requirements for the supply of materials used for manufacture of hot rolled steel products, cold formed steel products, hard drawn steel wire, and steel sections. The materials included may be in the form of billets or ingots and the semi-finished products may be in the form of steel sheets, flat rolls, or coils for wire drawings.
- (ii) Specification for hot rolled mild steel for reinforcement of concrete.
- (iii) Specification for cold formed steel sections.
- (iv) Specification for cold formed steel sections generally available in Kenya.

(c) Concrete/Cement:
- (i) Definitions and terminology used in cements.
- (ii) Specification for ordinary portland cement.
- (iii) Code of practice for detailing reinforced concrete in Kenya.
- (iv) Specification on aggregates from natural sources.

The above specifications were the initial documents that the section felt were needed for a newly established standards organization. Many more standards have been drafted in the section.

The Building and Construction Section follows a certain pattern in drafting standards in relation to buildings in and for Kenya. Briefly, these are as presented in Table 1.

Table 1: Information required for control.

	Title	Examples	Notes
A	Environmental factors	Climate Occupancy	Independent of designers control.
B	Functional requirements	Safety against collapse. Noise levels. Means of escape from fire. Ventilation--optimum conditions for air movement.	These are related to national interests.
C	Required characteristics	Structural character. Fire resistance periods.	Derived from functional requirements.
D	Techniques for design	Structural design. Measures for noise control. Design of parts.	Comprises both the design of systems and of parts. Wind frequency analysis. Solution to problems arising from chosen form of construction.
E	Techniques for contruction work	Specifications for preparation of materials. Specifications on workmanship.	Mainly for site use.
F	Techniques for operation and maintenance	Operation of plant. Recommendations for maintenance.	
G	Product specifications	Specification of materials. Dimensions, properties, and performance.	---
H	Performance assessment and quality control	Methods of test and assessment, i.e., procedures.	Either in relevant standard or separate, where they apply to more than one product.
I	Techniques for documentation	Presentation of technical information. Use of symbols. Graphical presentation.	Refer to basic standards requirements.
J	Standardization principles	Quality assurance of standard dimensions. Coordination with other relevant standards.	Mainly used by staff or senior Committee members.

4. THE BUREAU ACTIVITIES

The establishment of the Bureau noted the problems faced by the country's measuring instruments industry. The Bureau had to take immediate measures to draft a national standard on units of measurement, which was recommended for the whole industry and for investors into Kenya.

The Bureau further contacted the Government for establishment of a Metrology Centre. In 1976-77, we managed to conclude an agreement with PTB of Germany to finance and train our manpower and to construct a metrology centre in Nairobi. It is currently under construction and will be ready for operation in January 1980. The Metrology Centre will provide services to the industry in scientific metrology, calibration services, and instrumentation. This project is being carried out in collaboration with a foreign metrology services organization and the terms of the agreement include training facilities for the Bureau staff on the instruments they will use in Kenya--which is currently going on for 12 scientists and engineers.

General training of staff of the Kenya Bureau of Standards has been very much emphasized during the last three years since establishment. Training has been realized through other National Standards Organizations, e.g., in Japan, Britain, Sweden, Germany, India, NBS-USA, Australia, and the defunct East African Community. This training has helped bring divergent experiences into the Bureau which has helped in accelerating the Bureau activites.

The Kenya Bureau of Standards organizes every year in October--one is going on now--a Company Standardization Seminar, to which we invite all technical officers of industry, at the graduate level or higher, who are involved in running of the processes or running of industry or design of it, etc. This happens every year. We require them to pay a nominal fee, about $30. We keep them there for 12 days, after which they go back to the industry. We give them projects, they come back after two weeks, and we review what they have found out and tell them how to do it. The lecturers for these seminars are drawn from the staff of the Bureau. After a number of us had gone out for training, say, six weeks in Britain or Japan or Sweden, we said now we don't want any more experts to come, we already have the indigenous experts, so read the papers, read the documents, teach the boys how to do quality control in their industries and how to set up company standardization, and maintenance manuals, and the rest of it. So that is done by all of us, Kenyans. The event has been very popular among the industrialists in Kenya, although the upper hand of the foreign element in the investments has been uncooperative in most cases.

Although it is not easy to realize immediately the activities of a Standards Organization in the economy of most developing countries, there are prospects of the organization being very important in the day-to-day management of the economy in order to create more order in goods/money-worthness and quality.

II. INPUT TO U.S. PREPARATIONS FOR THE UN CONFERENCE ON SCIENCE AND TECHNOLOGY FOR DEVELOPMENT

I will address myself to the problems of my country and the problems of most of Black Africa, not just Eastern Africa. I will not address myself to the problems of Korea -- it is at the head of the queue.

The Seminar is supposed to give NBS and the United States Government some background data relevant to the UN Conference on Science and Technology for Development. I will give this as my personal view in terms of what should be done in an economy of the Kenya model.

The first and foremost problem, which has been taken up by most of you, is manpower availability. We need trained manpower, we must have a committed manpower, before we can have an effective standards organization. To train this manpower, what must we do? I am going to address myself to solutions of how best, I think, this should be approached.

1. In newly industrializing countries, the system of standardization should be considered the most effective means of management of the national economy and should assume a compulsory status.

2. Newly industrializing countries must develop an accumulation of indigenous know-how and manpower to help in a suitable standardization process. The development of this capability and ability could be achieved through the following systems:

(a) Consultancy Services -- whereby collaboration or joint ventures are worked out with indigenous firms or personnel for transfer of know-how in methods of work analysis, evaluation, and design principles consideration. This should cover industrial processes, investment feasibility studies, operation, installation, and management procedures.

There are a number of projects that are going on in developing countries, consultancy services. All these things involve lots of technology. They involve lots of knowledge that the developing country can accumulate, for their own manpower. And these consultancy services are normally carried out

without a single indigenous person involved in this sort of thing. The aid comes in, then they go. They say, all right, you do need the fish, eat it. You eat it today, but you cannot fish another fish the following day.

(b) Investment Agreements -- whereby training programs covered are geared towards genuine take-over by indigenous personnel within the period agreed to at the inception of the project but not a situation wherein the investor manages indefinitely by crisis. These agreements must contain all maintenance and operation clauses geared to the education of the recipient countries in these aspects.

Most of the agreements for investment in developing countries lack a take-over and a training portion. A lot of know-how is still retained, as the foreigner or the investor comes in and says, "Look, if that switch goes off and that portion of the transformer is blown, we'll call in Joe from Colorado." Well, this is costing a number of developing countries a lot of money, yet all the systems could be taught, and they should be.

3. Training programs should be encouraged between newly industrializing and industrialized countries for exchange and review of progress made in achieving industrial development and also to train management Technocrats from newly industrializing countries. These programs should be convened more often at regional levels in order to address the participants to their specific needs and capabilities.

4. All newly industrializing countries should be encouraged and assisted to form standardization organizations -- which must include specification divisions and certification in quality control sections.

5. Newly industrializing countries should have a system of developing the indigenous use of their resources, particular emphasis being placed on raw materials, i.e., major cash crops development.

6. Major research and development projects must not and should not take the shape and interest of only developed nations, e.g., solar energy all over the world oriented towards heating rooms as alternative energy -- rather newly industrializing countries should direct their research to developing a solar kettle for tea making or a solar pressure cooker for use by rural communities who cannot afford the high cost of fuel and to control desert approach through saving our forests.

7. The social standards should be respected and supported. There are a number of international investments going on like housing developments and industries, which ignore the social habits of the people. These are all standards within themselves. They need to be maintained. And I think that we ought to incorporate and make this a component part of investments, that the traditional habits and the traditional standards are maintained while we are trying to invest and get these amenities through to the local people. The main anomaly has been noticed in housing schemes, where housing provided rarely serves the social problems although it provides shelter.

8. I would recommend that the United Nations make it compulsory that all members of the United Nations should have a standardization organization established in their countries. All of us here have known the significance of this organization, and the significance of having a standards body. We should make sure that others, also, who have not been aware, benefit out of it, and this is the only way that we can create a unified system or unified order, all over the country.

In conclusion, I say that although the present level of industrialization of most countries is increasing, as for our future, it is based mainly on the assistance that we can get from industrialized countries. I also feel that industrialized countries have the ability and the capability either to resist or to implement industrial development in less-industrialized countries. And I only hope that we shall have a more humane cooperation, that although you have the means to resist, you also have the means to implement, that we compromise and get these things done, for the benefit of all of us, as a human race.

PAPER 3.7 - PROGRESS OF STANDARDIZATION IN THE SUDAN

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1. INTRODUCTION

Sudan realized the importance of standardization long ago. Early in 1961, the Ministry of Commerce, Industry and Supply invited a division chief officer from the British Standards Institute to give advice on the matter and to study the possibility of establishing a national standards body. After viewing the structure of the industry, he recommended that a small panel of experts with technical knowledge of the conditions under which imported goods and materials are used, should first be appointed. This panel, which should later develop into the official Sudanese Institution for Standardization, should as a first step obtain the official standards applying to certain imported products, and should study through short missions to the factories of the countries of origin, the possibilities of improvement or simplification to suit local requirements and conditions. Tentatively, specifications should be prepared and should be kept under constant review during their application. Unfortunately, for various reasons, it was not possible to put these recommendations into effect.

2. SPECIFICATION AND MECHANICAL TESTING DIVISION AT THE INSTITUTE

The Industrial Research Institute, which had been established in 1965, is a national, non-profit-making institution. According to its act the Institute is supposed to assist the Ministry of Industry in preparing Sudanese Standard Specifications for industrial and commercial products. So in 1967 a small section was formed to start the work on standardization. The work accomplished by this section till the formation of the Sudanese Organization for Standardization in 1968 could briefly be summarized in the following:

1. Establishment of a library containing most of the National Standards (British, Indian, DIN, etc.).

2. Preparation of about ten drafts standards for different industrial products which are manufactured locally.

3. Assisting the Ministry of Industry in formulating the constitution for the Sudanese Organization for Standardization.

4. Publishing a manual to be as a guide for members of the technical committees.

3. SUDANESE ORGANIZATION FOR STANDARDIZATION (S.O.S.)

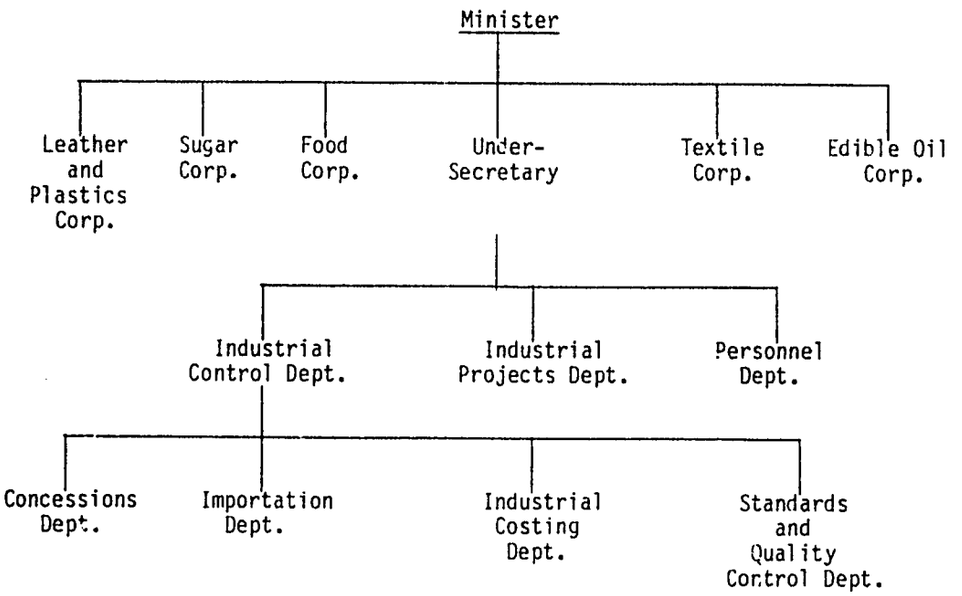
In 1968, S.O.S. was formed in accordance with the Organization and Promotion of Industrial Investment Act 1967.

A council including most of the concerned official and non-official Ministries and bodies was then formed, headed by the Permanent Under-Secretary of the Ministry of Industry. The Council set up four permanent committees, and technical sub-committees were established. This organization did nearly nothing in the field of standardization during its four-year period of existence.

4. STANDARDS AND QUALITY CONTROL DEPARTMENT

In 1972 the Promotion of Industrial Investment Act was amended and at the same time the whole structure and organizational chart of the Ministry was rearranged as shown in the attached chart. Accordingly, the Standard and Quality Control Department was formed with the following functions:

Organization Chart for the Ministry of Industry



(a) To prepare and promote standards at the national level with the cooperation of all other institutions and other concerned bodies.

(b) To cooperate and exchange information with the other national, regional, and international bodies in the field of standardization.

(c) To undertake tests and analyses of the locally manufactured products and to issue certificates accordingly. The tests are usually done in one of the specialized laboratories, namely:

1. Sudan Industrial and Consultancy Research Institute.
2. University of Khartoum Laboratories.
3. Ministry of Health Laboratories.
4. Food Research Institute.
5. Building Material Research Centre.
6. The laboratories of the factories themselves (sometimes).

(d) To give advice and help existing industries on matters of quality control.

The Department has carried out a lot of work until now in the field of standardization. It is now a member of the International Organization for Standardization (ISO), and the Arab Organization for Standardization and Metrology (ASMO). Steps have been taken now to join the newly formed regional African Organization. The Department is preparing and finalizing a number of standards every year, alongside with the continuous checking of the locally manufactured products.

5. CONCLUSION

As can be seen, the real work on standardization has been started recently. So in the last two years the Department has contacted several regional standards bodies for helping in establishing an ideal national standards body. The final work in this respect is now being carried out by the National Bureau of Standards, the Arab Organization for Standardization and Metrology, the Standardization and Quality Control Department, and the American AID. We hope the recommendations of this study will be implemented directly.

PAPER 3.8 - STANDARDIZATION IN TUNISIA

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1. INTRODUCTION

As early as 1919, Tunisia felt a need to curb fraudulent dealings in food and agricultural products. Supply difficulties in the years 1914 to 1918 caused a sharp drop in quality and the emergence of substitutes. Because of this, a decree promulgated on October 19, 1919, called for a check on fraudulent dealings in the sales of commodities, farm products, and raw materials. Soon thereafter an official laboratory and an inspection office to uncover and penalize fraudulent transactions were established.

It was only after World War II that Tunisia promoted foreign trade. This commercial drive that permitted the country to export farm and processed products, made it necessary to enact and enforce export regulations requiring exporters to adhere to clear-cut standards of description, grading, calibration, presentation, and packing.

When Tunisia attained independence in 1956, most manufactured items were imported from abroad. In the subsequent years, our government embarked on an industrialization drive. Successive development plans placed much emphasis on industrial development which would enable us to achieve some of the most essential objectives: increasing the national income to cope with the population rise; finding new outlets for our excess farm produce; eliminating regional imbalances; creation of new employment opportunities; saving foreign currency by substituting domestic for imported products; and earning foreign currency by opening new markets abroad.

As one can see, our objectives were twofold: first a quantitative objective, which means that Tunisia's entire industrial production should be increased, and second a qualitative objective, which means that production should be geared towards more efficient economic and social use. To this end, standards were developed for processed products, and those set for agricultural and natural products were improved.

The Standardization Office, reorganized in 1962, was made part of the Office of Trade which was responsible for setting standards for agricultural products in cooperation with appropriate technical departments. On the other hand, the Industrial Product Division, placed under the control of the Under-Secretariat of State for Industry and Trade, was entrusted with the task of developing standards for industrial products. At the same time, efforts were made to modernize laboratory equipment in the Central Laboratory, the National Office of Olive Oil, the Wine Office, the Agronomical Research Institute, the "Pasteur" Institute, etc.

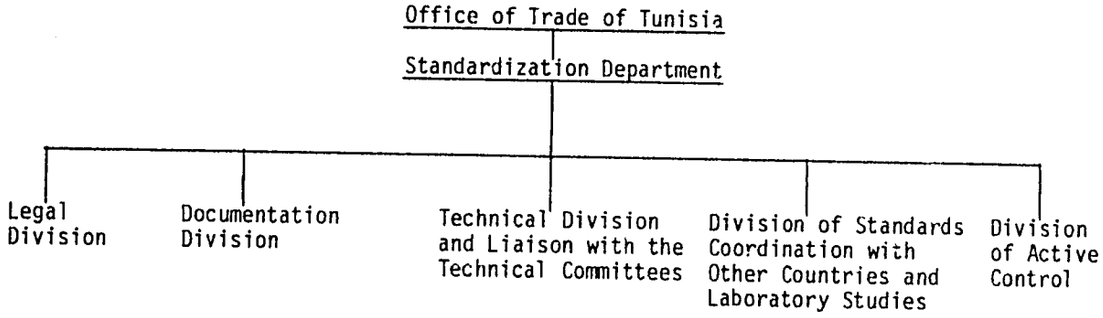
Although, standards now in force in Tunisia concern almost exclusively agricultural products and food commodities, and only few industrial items, efforts are being made to harmonize national standards with those in use in the countries who are our principal customers and to extend such standardization to other industrial products, while putting the coordination of the whole scheme in the hands of a National Institute of Standards.

2. STANDARDIZATION OF AGRICULTURAL PRODUCTS BY THE STANDARDIZATION SERVICE

2.1 History

Standardization was initiated in Tunisia in 1934 under a law decreed on January 12, 1934, which entrusted this task to the "Office Tunisien de Standardisation" (O.T.U.S.). This included fresh agricultural products (dates, citrus, vegetables, fruit, cereals, wine, olive oil, fresh fish) and handicrafts. In pursuance of the Executive Order dated January 18, 1934, a quality label, "Tunisia", was established in order to certify the origin and the quality of Tunisian products intended for export. By a decree dated July 19, 1939, quality control was made compulsory for some 48

The Standardization Department organization chart



products including canned foods and sea-salt. However, this control system became effective only after World War II, in 1946. After a number of intermediate organizational changes in April 1972, standardization was assigned to the Tunisian Trade Office. In 1953-54, we created the Laboratoire Central, which is a national laboratory to control all products manufactured by the state or imported or for export.

2.2 The Standardization Department Operating Procedures

Developing standards calls, to a great extent, for initiative and support by professionals both to determine criteria and to enforce them. In pursuance of a law decreed in 1950, the Central Standardization Commission, which included representatives of various interested administrative and professional groups, was entrusted with the task of studying all measures related to standardization. This decree-law also provided for the establishment of specialized subcommissions each dealing with a specific product or class of products, whose task was to develop specific standards. The proposed standards, once approved by the sub-commission, are passed on to the Standardization Commission in the form of a draft project. Once approved, the project is forwarded to the supervising office to be published in the Official Journal to become an enforceable regulation. At present, several executive orders dealing with standardization, issued in pursuance of an October 22, 1953 decree, regulate the control of fresh and processed agricultural products, before their exportation. These executive orders were revised, adapted to export market requirements, and issued in 1969.

2.3 Standardized Agricultural Products

Agricultural products presently standardized are:

a) Primary Agricultural Products

Fresh fruits: apricots, almonds, cherries, pomegranates, melons, peaches, grapes
Vegetables: artichokes, carrots, marrows, green beans, turnips, onions, leeks, potatoes, lettuce, cucumbers, olives
Dry fruits
Citrus fruits
Dry almonds
Dates
Ground sweet peppers
Fruit pastes
Milk
Muscat wine
Shell-fish and fish
Olive oil
Olive-cake oil
Sponges

b) Preserved Foods

Canned fruits
" fruits with syrup
" fruit and vegetable juices
" vegetables
" olives
" peppers (Harissa)
" dry peas diluted with water
" tomatoes (whole tomatoes, peeled, ground or mashed tomatoes)
Jams, jellies, marmalades, preserves
Canned fish and shell-fish

c) Others

Ice-cream, non-alcoholic beverages, margarine

2.4 Technical Committees

The existing technical committees are mainly committees dealing with agricultural products, both processed and not. They are 12 in number, namely:

The Technical Committee on citrus fruits.
" " other fresh fruits.
" " vegetables.
" " cereals.
" " dates.
" " wine.
" " edible oils.
" " canned fruits.
" " " vegetables.
" " " fish.
" " candy.
The Technical Committee on sea-transport.

3. STANDARDIZATION OF INDUSTRIAL PRODUCTS BY THE DEPARTMENT OF INDUSTRY

Industrial products manufactured in Tunisia fall into two categories with respect to standardization.

3.1 First Category: Industrial Products Subject to National Standards. These include building materials.

- First quality burned-clay bricks, both hollow and solid.
- Mechanical tiles, authorized by an Executive Order dated May 28, 1947, based on the advice of the Building Materials Standardization Commission.
- Hydraulic building materials, authorized by the Executive Orders of June 16, 1950 and August 23, 1954, based on the advice of the Building Materials Standardization Commission.
- Cement rings manufactured by "El Fouladh", authorized by Executive Order No. 67856 of Sept. 11, 1967.

3.2 Second Category: Industrial Products Not Subject to Standards

The establishment of the Institute of Standards will make it possible to develop national standards for such products.

4. PROMOTION OF A NATIONAL INSTITUTE OF STANDARDS

Under the Tunisian social and economic development plan, an important part of this country's resources is dedicated to creating and expanding industrial firms in all sectors. Centers for regional development have been established or further extended in Bizerte, Sousse, Gabes, Kasserine, and Gafsa, respectively, for iron, textile, chemical, cellulose, and extractive industries. Furthermore, the electric, petroleum, mechanical, metal processing, and agricultural products processing industries are progressing well and contributing to a large extent to the growth of the national income.

It is opportune now, after the start-up period inherent to the creation of these complex industries, to establish a collection of standards in order to improve the production, marketing, and utilization of products intended for national needs and for export. Such standards provide the technical components needed for a quality control policy and comprise basic data required not only by industry but equally by laboratories, research organizations, and technical training institutions.

Surveying the present standards situation in Tunisia clearly shows that the prevailing conditions are most favorable for the establishemnt of a National Institute of Standards, particularly for the following reasons:

- Control of the type that would be exerted by an Institute of Standards is now carried out by the Standardization Staff of the Office of Trade for agricultural products, and by the Directorate of Industry for industrial products.

- A Central Laboratory, which provides the main expertise for developing and verifying standards, exists.

- Control is shared by the Office of Fraudulent Products and the Control Office of the Directorate of Industry.

A proposal for establishment of a single, central National Institute of Standards was sent to the Tunisian Government last month, and we hope before December that its

establishment will be approved. The motives that led to this proposal start with why it is necessary to have standards, some of which has been said earlier in this paper.

We think that both for our country and for developed countries, a standard is the means, the tool that you have to have before *all*, why you have to do research, either fundamental or applied. A standard is a reference resulting from a reasoned collective choice, with a view to be used as a working basis for the solution of repetitive problems. Standardization of the process of developing standards is designed in particular to identify -- based on specific categories of need -- appropriate ranges of products or methods best fitted to fulfill those needs, for the intended use, wiping away complication and superfluous variation. An objective is simplification, so as to permit rational production and actualization based on the technique in use at that moment.

Standards provide definitions, characteristics, qualities, testing methods, instructions for use, and so on. All these elements can be given separately, or combined together. Producer, distributor, user, public administrator, scientific and technical agency, other qualified persons -- all are required to contribute by means of jointly conducted surveys, to the development of Tunisian standards.

Tunisian standards will be defined and protected by law. References to a given standard may be made in a large number of technical survey projects, in the operation of processing plants, in supply programs, in commercial exchanges, in writing specifications, in public contracts, in administrative regulation, in export reports, and so on. The production, distribution, and utilization of commodities, as well as the national productivity will derive much benefit from it. Such benefits can only be established through national regulation, excluding any alternative or contradictory rules. The existence of national standards and their use also provide a much stronger position at future discussions on international standardization.

The present situation in our country in matters of standardization is marked by insufficient recognition and regulation by laws governing this activity, as well as by a lack of adequate institutional structures. This situation is growing more and more unbearable, given the remarkable growth of Tunisian industry and especially the ambitious objectives set for our exports. These gaps were brought out previously by the various economic and social development plans. Several projects concerning the establishment of a national standardization institute were worked out, but unfortunately did not materialize.

The introduction of standards in the economic field is warranted by the short- and long-term advantages which will be gained by both producer and consumer, as well as the country's economy as a whole. It is useful to mention a few of such advantages:

- Rational organization of manufacturing processes.
- Increase production and reduced losses and waste.
- Reduced cost, price, and idle stocks.
- Accurate guarantees as to quality, regularity, security, interchangeability, and so on.
- Access to technical data formerly secret and unavailable.
- Shorter delivery periods.
- Fewer and less intense disputes, as the manufactured products are better fitted for utilization -- quality, convenience, durability, efficacy.
- Better satisfaction of international markets.
- Increased national productivity.

These advantages explain the need to promote standardization in Tunisia through the creation of a National Institute of Standards, with the following objectives: centralization of standardization work; dissemination of documents prepared by technical committees; control over the actualization of approved standards; participation in the community of international standardization agencies; training of qualified personnel; development and preparation of proper regulations.

It is obvious that the Institute will see to it that any proposed standard be reviewed and accepted by all concerned parties -- producer, user, distributor, public administrator, scientific or technical agency, qualified person -- who will be grouped into specialized committees. The proposed standard, approved by the appropriate committee, will be passed on to the concerned Ministry for final approval and publication in the official journal.

Implementation of standards will be done as follows: All contracts entered into by the Government, local public organization, public enterprise, or state-subsidized enterprise shall require compliance with fixed standards. For contracts entered into by private individuals, any reference to a given standard shall be binding upon the parties; and the contractor who doesn't observe it may be held liable in courts. The implementation of standards in the private sector must be based on the advantages resulting there from, except for some projects considered of strategic importance, to be described later by executive orders.

Standardization, as an institutional support for the quality and reliability of both the manufactured item and the manufacturing process, cannot be dissociated from the control and approval of invention and innovation. As a matter of fact, the national development and industrialization programs in Tunisia remain widely open to foreign technologies, but must, at the same time, favor and encourage the national aptitude for invention and innovation. However, such encouragement must not become a matter of over-riding priority, as the end objective remains the interests of users and the country's economy. It is, therefore, necessary to propose to proceed to an evaluation and selection of foreign techniques that are best suited for our country's needs and potential, and afterwards to review and approve methods for such technological transfer on the basis of the objective assistance rendered and patent rights. It is also necessary to examine the veracity and the soundness of invention and local processes with a view to issuing appropriate patents. That is why the Standards Institute will, in addition to its normal duties, be required to review all technical plans accompanying a request for a patent before registration, to give its opinion about foreign technical processes and patents.

For a developing country, a Laboratory is a means, it is not the end, of a thing. What is important is the help the institution can give to control of the quality of our products. We have another organization in Tunisia which is concerned with standardization in Tunisia, which is an institution for research. We have three universities which are looking in research into standardization. We have a specialized University of Technology and Science with a staff which includes many engineers. Our universities grant degrees for the masters or the Ph.D., and others, but they have not specialized in the education for manufacturing or for the job itself, and we now have unemployed white collar workers. It is our big problem that we have to resolve, to motivate our population to work with its hands, not only to seek positions as directors or as chiefs.

We have to apply the standards that we have. In many cases, the only ones available are from the developed countries. These standards are often different in the Common Market, the USA, Japan, and other developed countries. With the new institute, we will try to choose the standards that are of interest to us, not only for export purposes but also internally for our country.

We are industrializing our country, not in a hurry, but step-by-step, based on a choice of the technologies which are offered by other countries. We now have technical depth. We can adapt imported technologies to fit our means and our raw materials. It is easier to say than to do it, to industrialize a country. We want to avoid situations in which a manufacturer finds after working for six months that his product cannot be exported, because these products exist already in other countries at a lower price. So we have to go step-by-step, but we have to go. We can't stand still.

PAPER 3.9 - STANDARDIZATION IN SAUDI ARABIA

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1. STANDARDIZATION ROLE IN SAUDI ARABIAN DEVELOPMENT

The impact of standardization on the Saudi economy is immense. It became more apparent after the 1973 energy crisis when Saudi Arabia emerged as a world economical power and assumed a very influential role in the international market. The great demand for oil has exerted a pressure on Saudi Arabia to produce much more oil than its plans call for, and thus has multiplied its revenues, and dictated a very ambitious second five-year plan in 1975. The main goals of that plan were:

(1) To develop alternative sources of income by more intensive mineral exploration missions.

(2) To establish an industrial base for the country.

(3) To improve the quality of human resources.

To implement this plan required the establishment of the basic facility infrastructure needed, like houses, roads, utilities, communications, etc., and to do that required the importation of the know-how and the manpower from different parts of the world. The Saudi doors, which were closed, were opened and many skilled and non-skilled foreign workers poured into Saudi Arabia in a very short time.

The Country was not ready for this. The prices of commodities and services reached a staggeringly high level, and thus the inflation rate was rising vertically in 1974, 75, and 76. The great demand for goods allowed for the importation of very low quality products, and the huge volume of imported materials coupled with limited quality control capability at the ports made the Saudi Arabian market a dumping place for factory rejects and sub-standard products from different parts of the world.

It was during that period that the Saudi Arabian Standards Organization (SASO) played a great role in protecting the consumers, guiding the businessmen, and helping the economy. SASO has been charged with establishing quantitative and qualitative standards which are mandatory, with applying a quality mark and certification; and with increasing public awareness of the importance of standardization. After passing through the organizational stage, SASO adopted in 1975 a five-year plan of its own, and top priority in drafting standards was given to food products and construction materials; food, to feed the many imported workers; construction materials to use in our building boom. The plan calls for 300 standards to be approved by 1980. We have now completed 112 and 40 more are waiting for final approval, so that I am sure that by 1980 we will finish more than 300.

SASO is also playing a great role in informing the public of the importance of standardization through newspapers, specialized magazines, radio and television stations. One of the problems we are facing at SASO is that of "image". We are trying to improve our image with the people, to increase their confidence in what we are doing, to encourage them to use standards, and to understand standards. Really, one of the big problems that we are facing is that it is not only the laymen who don't understand standards, but many in the government themselves do not know the advantages of having standards. So that awareness of the people is very important, we think, for the success of our organization.

Regarding the other very important task of applying quality-mark and certification systems -- I wish other countries would do this regarding their exported materials -- SASO has not yet done anything because SASO does not have its own laboratories built. As soon as the analytical capability is acquired, this system will be applied.

This brief presentation reveals the influence SASO will have in the economical development of Saudi Arabia. SASO will set the foundation rules for establishing the basic industries and also assures the consumer of the quality of the products and the safety of their use. All of this indicates that standards do supply some of the knowledge for Saudi Arabia that will help in deciding whether a technology is appropriate and whether the necessary equipment is suitable.

2. GENERAL PROBLEMS FACED BY SAUDI ARABIAN STANDARDS ORGANIZATION

Standardization has become a very comprehensive universal discipline with its own special features and characteristics. However, each country is applying standards in its own unique way.

The Saudi Arabian Standards Organization was established toward the end of 1972. The first three years were mainly spent on administrative and technical staffing of the organization. As mentioned above, in 1975 SASO adopted a very ambitious five-year plan to keep up with the national five-year plan of Saudi Arabia. At the beginning SASO was concerned mainly with establishing standards for commercially oriented society, but later its role was shifted toward establishment of standards for new industries as well as imported commodities.

The main problems SASO is facing in efficiently carrying out its tasks are typical of any developing country's problems. Principally, these problems are:

1. Qualified technical and administrative staff are not easily available.

2. Research and Development laboratories are not readily available.

3. Standards have to be drafted by SASO due to lack of free qualified experts in the country.

4. The quick increase in size, about 10 times, of foreign imports has placed a greater pressure on SASO.

5. The problems of the SASO image in the public eye.

In conclusion, it is the general feeling of the people at SASO that the most effective way by which industrialized countries can help is by applying the certification and quality-mark systems to all exported products.

PAPER 3.10 - STANDARDIZATION IN JORDAN

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1. INTRODUCTION

In 1970, the Government of Jordan decided to carry out a policy measure of setting up and enforcing internationally recognized standard specifications aimed at insuring the good quality of local products, in order to protect the consumer and earn a good reputation in foreign markets. In 1971, a Directorate of Standards within the Ministry of Industry and Trade was established to be the competent national body on standardization and quality control. The following year, the standardization law No. 24/1972 was promulgated.

In an effort to promote standardization activities and to ensure the efficient operation of the Directorate of Standards, the Government executed a large-scale project aimed at strengthening activities in the relevant fields of standardization, namely, specifications, testing, quality control, certification marking, and standard weights and measures. This project also included the setting-up of Industrial Testing and Quality Control Laboratories (ITQCL) to provide the necessary facilities for analysis for the standardization of the measuring instruments used in trade and commerce.

2. OBJECTIVES OF THE PROJECT

2.1 Long - term

The long-term objective of the project is to improve the national economy by strengthening standardization and quality at the in-plant and national levels, which will help to improve the quality of locally produced goods and make the use of local raw materials more efficient and reduce costs. This, in turn, will help to ensure fairness in trade and commerce, control of imports, and promotion of exports.

2.2 Short - term

2.2.1 Standard Specifications.

(a) To organize and strengthen the operation of the Directorate of Standards, related to national standards.

(b) To elaborate and carry out a national programme of standardization.

(c) To bring about the application of national standards and to assist in the establishment, organization, and operation of standards departments in industrial enterprises.

2.2.2 Testing

(a) To set up, organize, and operate the Industrial Testing and Quality Control Laboratories (ITQCL).

(b) To co-ordinate the facilities of the ITQCL with other testing facilities in Jordan.

2.2.3 Quality Control

(a) To develop a national quality control scheme with a view to improving the quality of goods and products in the domestic and export markets, thereby protecting consumers and promoting the export trade of Jordan.

(b) To develop quality consciousness in the public and industrial establishments.

(c) To organize and operate a national quality certification scheme, whereby the standards and quality marks would be granted to products conforming to national standards.

2.2.4 Legal Metrology

(a) To establish, organize and operate a central standards laboratory in Amman and district weights and measures offices in the main governorates of Jordan to accommodate reference standards.

(b) To plan, organize, and implement national metrological services.

(c) To effect the smooth transfer to the metric system.

2.2.5 General

(a) To set up an information centre for the dissemination of technical information relating to standard specifications, testing, quality control, certification marking, and legal metrology.

(b) To train national personnel in standard specifications, testing, quality control, and legal metrology.

(c) To increase the participation of Jordan in regional (ASMO) and international (Codex Alimentarius Commission, EOQC, IEC, ISO, OIML, ASTM) organizations in the fields of standardization, testing, quality control, and legal metrology.

3. JOB DESCRIPTION OF THE DIRECTORATE (As prescribed in the law No. 24 of 1972)

1- Determine standards and measures, amend the same as it may deem necessary, work for the universalization of their use, and publish information related thereto.

2- Prepare draft standard specifications for the commodities and materials produced in the Kingdom with a view to determining their quality and facilitating their commercial dealing in the Kingdom and abroad.

3- Issue the standards approved by the Council of Ministers to be standard specifications.

4- Prepare technical terms and set procedures for examining, testing, analyzing, supervising, and inspecting commodities and materials with a view to determining their quality and specifications.

5- Coordinate the Jordan Standard Specifications to the extent possible, to conform to the recommendations of the Arab Organization for Standardization and Metrology (ASMO) and the International Standards Organization.

6- Prepare a special Mark, hereinafter referred to as Quality Mark, to be used by the producer or exporter for the commodities and materials which conform to the Jordan Standards as an indication of their quality.

7- Encourage the use of labels and manifests or, as it may deem necessary, make their use mandatory on containers, for the purpose of guidance.

8- Make agreements with similar Arab and international organizations with a view to permitting them to use the Jordan Quality Mark, on the condition that such organizations shall, before the use of the Jordan Quality Mark, carry out inspection of the commodities and materials concerned with a view to making sure they conform to the Jordan Standards.

9- Recognize, on the recommendation of the Director, the standards of other states for the periods which the Ministry may decide with a view to regulating and supervising the commodities and materials produced in Jordan, exported or imported.

10- Approve laboratories and procedures for examining, testing, analyzing, supervising, and inspecting commodities and materials subject to Jordan Standards.

11- Prepare or encourage the preparation of studies and research work in different fields in relation to standards.

12- Encourage the industries of Jordan to improve the quality of their commodities and materials, and collaborate on improving the level of these industries, protecting the consumer and suppressing adulteration, by means of determining the specifications and conditions with which the producer, exporter and importer shall comply.

13- Keep the essential reference standard units which it requires for the verification of measures with view to ensuring the extent of their accuracy and compliance with the reference standard units and impressing

thereupon the seal which the Ministry determines.

14- Cooperate with similar Arab and international organizations and represent Jordan in Arab and international conferences on standards and measures.

15- Take any other steps which may assist in discharging the functions above.

4. REGIONAL AND INTERNATIONAL ACTIVITIES

The Directorate of Standards is a full member in the Codex Alimentorius Commission (CAC), a correspondent member in the International Organization for Legal Metrology (OIML), and a correspondent member in the International Organization for Standardization (ISO). We have also a varying level of relationships with Arab standards bodies as well as with foreign standards bodies.

The Directorate of Standards is a full member of the Arab Organization for Standardization and Metrology (ASMO). Our technical staff participates in the technical committees to draft and finalize the Arab standards, and they also participate in the seminars and training courses that the ASMO holds almost every year. The Director of the Jordan Directorate is a member of the ASMO board.

5. RECOMMENDATIONS FOR THE DEVELOPING COUNTRIES IN FIELD OF STANDARDIZATION

To start without any delay in establishing standardization organizations and quality control in their countries, if these have not already been started.

To try, if possible, to work in regional organizations for standardization.

To try to participate as a full member in the International Organizations.

To try to operate certification marking schemes, so as to facilitate export to foreign markets.

Science and technology and research centers are very necessary to cope with every movement in the field of standardization.

What is required from developed countries is assistance in establishing organizations for standardization. Also, the developing countries are depending upon imports from foreign countries where they have different specifications and different dimensions for the same product. That leads to difficulties in keeping spare parts and good maintenance. So working on international specifications and metrication will help indirectly the developing countries to look after their own problems.

DISCUSSION:

Mr. Hamilton Herman:

If one has a group of good technically trained people, there isn't any reason why these people cannot do more than one thing. In short, a good engineer is capable of understanding standards and is also capable of the application of technology. So my suggestion is this, if one has limited funds, one does several things at once, and one uses his engineers broadly at least at the outset. At the moment, for instance, a country I have visited recently is using the same engineers that are doing the development work to establish environmental controls also. One can say that that is not a good thing, that they might approve something they wouldn't otherwise approve, but nevertheless, my suspicion is that they get 85% of the pollution control needs met even within that framework, and they save the elaboration of a separate organization and a lot of money. So my comment is that while standards are important, it is the overall use of the technology that is going to count, and one may be able to stretch his engineering dollars by combining these things, particularly at the outset.

Dr. Jose L. Tudor (Barbados National Standards Institute):

I see one area in which this idea of drawing on the technical knowledge of technical

talent to do other things than write and interpret standards can be applied in a very practical way. One aspect is in the area of servicing and maintenance of equipment, particularly the test equipment that is so very important in maintaining quality control in industry and in standards institutions, and that sort of thing. Another is to encourage the development of instruments designed to do the particular things and to meet the needs of particular industries in particular environments in the developing countries, instruments that their own technical people will be familiar with and know how to service. One of the problems that one is very often faced with, especially in the developing countries, is having very sophisticated instruments that can do very much more than meet the requirements of the developing country, and for which there are very few people knowledgeable enough to service them properly. Since there is the availability of relatively cheap electronic devices which form components in many of these instruments, I would like to see someone in a position to invest in the technology of instrumentation as applied to the areas of quality control, materials product testing, etc., which will alleviate some of the problems that we hear about.

Dr. Al-Khalaf:

I sure agree with you. Also, I think that if a person uses a simplified machine at the beginning, he can understand the whole theory and application behind it, but if he is hit with a very complicated one, he probably knows how to operate it, but he doesn't know anything about it. I sure believe in what you just said. And it would be nice if they could make instruments that do not need maintenance at all--just get the instrument and use it.

Prof. Lieberman:

I think that there is possible danger. My observation is that if you look at some of the so-called standards laboratories around the world in various countries, that frequently these have turned into, also, scientific laboratories, of the highest order, and that a lot of your instrumentation, a lot of your standards work is being done by scientists. Now, I want to call your attention to the difference between a scientist and a technologist. A scientist is not going to go out in the field and worry about a pump, and do the kind of work that you want him to do, also. So it may be that you need another kind of person. You have to be very careful about this. Your man doing your standards work may be a scientist, but you need a field engineer to really go out and do things like developing new products. In your countries, who is doing standards work: scientists or engineers? Is standards work now being done by the kind of person who can go out and design products?

Mr. Owino-Okwero (Kenya):

I do standards work. I am a civil engineer. I design roads, I designed buildings, I can design, also, structures, etc. I have been in the field before. I have that experience. And that has been a criterion in training of most of our standards employees. Of late, we train graduates direct from the university, and we find them not very useful, because they cannot follow the technical committee discussions. So we are taking them to industry to learn how to design, to gain field experience, and to learn a little bit of production engineering. I agree with you, you need people who can get out and design things.

PAPER 3.11 - COMMENTS ON STANDARDIZATION

Dr. Robert W. Middleton
Assistant Secretary General
International Organization for Standardization
Geneva, Switzerland

I would like to respond to some of the points made here this afternoon.

To Mr. Belford, you need not in any way be apologetic. I like very much what you said, and I think it does a great deal of good to take the lid off the internal workings of the ISO committees. I was expecting something far worse. I think it is absolutely correct to point out that standardization is a business function. At the same time, I think you were quite correct to emphasize that there is, in all the ISO work, a spirit of compromise and concession, which means that in fact agreement is reached and positions are not polarized. Secondly, in respect to the possibilities of taking over ISO standards directly, I think it should be pointed out that this particular problem relates essentially to product standards. As far as the large majority of the ISO standards are concerned -- test methods, terminology, sampling -- it is possible for these to be taken over directly and integrally as national standards. In fact, both the Germans and the British are following this course, so it is not a matter of the size or level of development of the country.

Today, standardization is attracting increasing political importance. We have tried to assist the Secretariat of the United Nations Conference on Science and Technology by pointing out to them that it would be incorrect for them to forget the subject of standardization in this Conference. We have, also, at the end of last year written to our members saying that they should take this matter up with their governments, with a view to ensuring that the matter is included in the government position papers. It would be a tremendous pity if the political impetus that is going to be gained from the United Nations Conference were not to be spread also into the area of standardization. And I would make an appeal to all those here to make every effort that they can at the national level to ensure that whatever comes out of the United Nations Conference on Science and Technology, there is something in it for standardization, and for all of our standards institutions.

SECTION 4 - KNOWLEDGE REQUIRED FOR INDUSTRIAL QUALITY CONTROL

Chairman: C. B. Butts, Supervisor, Equipment Engineering
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PAPER 4.1 - ESTABLISHING A QUALITY CONTROL SYSTEM IN AN INDUSTRIALIZING COUNTRY*

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1. INTRODUCTION

The author is keenly aware of the importance, necessity, and humane right of the developing countries and their individual citizens, to achieve a rapid, balanced, and sure standard of living, equivalent to that enjoyed by many developed nations. Experience has shown that *Quality* and its related disciplines have played a significant role in bringing about an improved standard of living for the industrialized countries and those rapidly reaching that status. These same concepts and disciplines will likewise be of great importance to the developing nations.

But, as yet, there are places on the face of the earth where cheap labor is and can be exploited to achieve a competitive edge in the manufacture and sale of various products and commodities. However, as developing countries cross the threshold to the "developed" status with resultant benefits in better standards of living for the populace, and as international standards and trade with developing countries increase, emphasis will shift from cheap labor to good quality for the competitive edge. Examples already abound, notably from Japan, Republic of Korea, Republic of China, Mexico, Israel, Singapore, etc.

The exploitation of cheap labor is, at best, only a stop-gap activity in world supply and demand. A quarter century or more ago U.S. (and other) companies established operations in Japan (and elsewhere). Now Japanese (and other) companies are establishing operations in Korea, Thailand (and elsewhere). The cycle continues, but the emphasis moves closer to better quality at a reasonable price.

Quality Control, correctly applied with an awareness of the importance of quality, can provide the active ingredient needed to achieve domestic and export quality and the resulting good reputation for products, "made anywhere". Quality Control is now widely used in almost every type of industry in most countries of the world. It was, and is claimed by many of the Japanese leaders to be, the key to the tremendous economic prosperity and growth that has occurred in Japan. One of the consultants that helped the Japanese program in the late 40's and early 50's was a man that is very close to us here, Dr. Edwards Deming, and he is quoted as saying "Japanese management listened, they learned, they observed, and they did something about common quality problems." The world knows the benefit of that work.

It has proved to be most effective (1) in improving the quality of products, including life and reliability, (2) in raising the productivity of manufacturing processes, (3) in reducing manufacturing and other costs, and (4) in timely deliveries and in determining the marketability of products or services.

However, many developing countries have yet to promote, utilize, and benefit from quality control on a national scale. Most are receiving some assistance and are interested in developing. Understanding the principles and benefits and placing them in proper perspective will surely help. It must also

* Portions of this paper are abridged from the forthcoming publication by the author on "Preparing for Standardization, Certification and Quality Control", reference 1, and are used here by kind permission of the publishers, the Asian Productivity Organization.

be understood that the commonly heard resistances to quality implementation such as, "our problems are different," "it will cost too much," "management will not accept it," etc., have been voiced before most successful applications, regardless of degree of development and/or scope of application.

Many developing countries around the world stand on the threshold of rapid industrial development. If this development is to be successful in achieving domestic and export acceptance of locally made products, quality, price, and delivery must be placed in proper perspective and continually improved. Management personnel in government departments; private industry; management, professional, and trade associations; academic institutions; etc., must develop a genuine and growing interest in the use of quality control and all its facets to achieve these results. Awareness of the importance of quality, the specifications of desired and aimed-at quality, and planning for quality are essential decisions and actions for governments and industrial and commercial enterprises - whether small or large. Establishing a quality control system is hardly an alternative, it is becoming a necessity for the economic and humane well-being for any nation.

2. QUALITY CONTROL PROGRAM DEVELOPMENT

Quality Control programs and applications have grown rapidly in developing countries over the past decade with considerable promotion by such international organizations as UNIDO, APO, and ISO, and by numerous bilateral programs, but also in no small measure by the inspiration of the phenomenal Japanese industrial and economic success coupled with no reluctance on their part to credit much of their progress to the establishment of a quality control consciousness and to application of quality control methodology and management. Considerable impetus for quality control program development and industrial applications has also been the result of the transfer of quality control technology by multinational companies and other foreign investments, joint ventures, licensing arrangements, etc. All of these avenues of assistance are generally available to developing countries just embarking on programs of industrial development and should at least be considered in the establishment of a national program.

The scope of a program of quality control is quite broad and needs to take into consideration both individual companies or factories, and national, regional, or international organizations and activities. Quality -- its attainment and control, like a precious gem -- has many facets -- each contributing to its sparkle and value. There are the *in-factory* programs of receiving inspections, raw material and piece parts inspection, vendor relations; process performance and capability studies; process controls; motivation of employee quality consciousness; failure analysis; reliability, life, and environmental testing; instrument calibration, and control; maintainability of plant and equipment; final inspection; product warranty and liability; customer relations and analysis of field use data; quality assurance; quality cost analysis; quality of design; management reports; organization for quality; etc.

On a *national* level there are quality control societies; other professional and trade associations; local, regional, and national seminars and conferences; training programs and certification of practitioners; university degree programs; publications and literature promotion; product liability legislation and government compulsions for quality and safety; standardization; certification and quality marks programs; export inspection programs; legal metrology; etc.

The multinational companies, bilateral and multilateral aid programs, such as the United Nations Industrial Development Organization, and other international organizations carry the in-factory and national programs over to the *international* level. As mentioned above, the world has seen, first hand, the tremendous economic impact of the transfer of quality technology from one culture to another -- notably the case of Japan.

What is needed in a developing country by way of a quality control program is also

dependent on the degree of development already attained. Dr. J. M. Juran [2] identifies five phases which an industrially developing country passes through on its way to full development. He recognizes the importance of standardization and the role of the National Standards Institute in this evolution and equally recognizes the necessity for complementary activities and organizations as industrial development progresses. His short, but cogent paper, should be consulted for more detailed study and information for industrial planners in developing countries.

Many papers have been written on quality control in developing countries, of which many are listed in the References section. All of them include, at least in part, the following recommendations for developing an effective quality control program at the national level:

1) *Establish* strong national *leadership and* a national *plan*, as through one or more influential national organizations, such as the national standards body, association of manufacturers, management associations, engineering and other professional societies, universities, etc. This implies the formation of a group or groups to spearhead the quality movement. This need not be a Q.C. Society, per se, but should be well organized, influential, and active. *Develop* a *quality consciousness* and concern for quality *in* key governmental, industrial, commercial, financial, and academic *leaders*. This may be done by arranging for internationally known experts to conduct seminars for such leaders to emphasize the importance of quality in a developing economy -- perhaps using the success of another country. (Japan can serve as an excellent example.)

In the national plan give serious consideration to the establishment of reasonable trade policies to encourage competition and quality improvement, while promoting local manufacturers. Promote exports and the necessity for local manufacturers to meet international quality levels and standards.

2) *Establish and* actively *support* and *publicize* a *national standardization effort*. The adjunct of a quality certification program with a publicized and recognized quality mark backed up by a sound program of initial factory inspections, product testing, surveillance inspections and testing, etc., is highly desirable. The development of a national capability in legal and industrial metrology and calibration is a necessary program to support the certification efforts and industrialization in general.

3) *Create* government and commercial *compulsion* for reasonable levels of *quality* via quality requirements in purchase contracts, building specifications, standardization and certification, export inspection programs, etc. Some quality requirements need enforcement from an organization or program with a broader perspective than the manufacturer himself or his immediate customer. (For example, the higher cost of electricity or even the cost of a fire from poor quality electrical cable is most often not borne by the manufacturer of the cable or by the construction contractor. Without some independent enforcement of such quality, they may be tempted to cut their individual costs by supplying a low grade cable.) There are at least two levels of compulsion which may be created. One can be referred to as a "subtle compulsion" obtained by the political-technical activity of convincing responsible authorities to specify or require quality in products and services. The other may be referred to as "hard core compulsion" obtained by the politico-technical-legal activity of decreeing by law that imported and/or manufactured products must conform to a given standard, with associated liabilities. Each of these forms of compulsion has its place in a national quality control system. Priorities based on national development, economy, and public safety must be established. Programs of enforcement, compatible with the requirements and scope of compulsion, must be established and supported to make the entire effort effective.

4) *Establish media for exchange*. Promote industrial applications. Hold seminars and publish transactions and journals in the local language. Develop training manuals, texts, standards, etc. in the local language. Develop study groups to study applications in

other countries. Request and implement local projects funded by outside aid. Direct these projects in accordance with the national plan. Develop local practitioners, lecturers, teachers, etc., for more intensive training.

5) *Establish* an *extensive* program of *training*. This can be organized and spearheaded by the Q.C. Society and/or other organizations such as management associations, industry associations, government departments, etc., especially for managers and practitioners. Academic institutions should be encouraged to develop courses for inclusion in key curricula. In-company training should be encouraged and assisted.

6) *Develop* a program to promote *public awareness of quality*, *safety*, etc. Public media such as radio, TV, newspapers, magazines and journals, even movies, should be used in this effort. Consumer organizations for representing consumer groups in negotiating better quality from monopolies, informing the public, etc., should be established. Involve workers (ultimate consumers) in programs of participation in quality improvement (QC Circles are examples at the factory level).

It should be emphasized that approaches to the tasks included in the above recommendations must be individually tailored to fit the distinctive requirements of the particular country involved. There is a strong temptation to simply observe what has worked in one country and then to apply it, unaltered, in another. This temptation should be recognized and resisted. The transfer of technology from one country to another has sometimes led to unanticipated difficulties and frustrations. If care is not exercised by those responsible in the developing country, the same kind of unhappy results may be realized with quality control as well as activities such as standardization, certification, metrology, etc. Thoughtful consideration, then, must be given to the problem of how to initiate and how to sustain a national quality movement that encompasses standardization, certification, quality control, and related activities. The resulting plan will undoubtedly be unique to that country. It is important to assess cultural differences when studying quality control programs of other countries. And, in most cases, adaptation is to be preferred over adoption, generally.

However, much can be learned from the experience of others, and within the constraints of adaptation to local circumstances and unique conditions, developing countries can often accelerate their advancement through the phases of development. Especially with respect to quality control methodology and management, the latest experiences can be learned and implemented immediately - without the necessity to evolve these principles.

The national plan should also be flexible because of inevitable internal and external changes and because, as experience is acquired, knowledge will be gained about which types of things work and which do not.

To mount and sustain a successful quality control movement on a national scale, it is necessary that there be at least one group somewhere in the country (perhaps in a governmental body or an academic institution) that is knowledgeable in quality control, aware at all times of latest developments in the field, capable of adapting techniques to local needs, and competent to provide consulting assistance. Ideally, such a group would be actively engaged in relevant research. It has certainly been the case in Japan, where a most vigorous national quality control movement is found, that a multitude of such support groups have been supported.

3. INTEGRATED STANDARDIZATION

A national standardization effort is included in the above recommendations for the development of an effective quality control program at the national level. It is also essential to support progress in industrialization. The concept of "integrated standardization" has emerged during the past decade or more and developing countries will do well to give it serious consideration in the organization of their standardization and quality programs. A recent ISO conference and its report [3] serves to formalize the concept by inclusion

of a somewhat comprehensive set of functions and listing as a formal recommendation the following:

"4.2 National standards bodies in developing countries should adopt an 'integrated approach' to standardization (embracing standards-writing, metrology, quality control, certification and applied research) as providing the best means of ensuring implementation of standards and their adaption to local conditions and of raising the level of quality."

Integrated standardization will include the following elements:

1. Standards preparation and promulgation

2. Industrial metrology -- measurement and calibration

3. Legal metrology -- weights and measures

4. Certified reference materials

5. Certification and quality marking

6. Export inspection

7. Applied research

8. Quality control

Systems of quality control and quality assurance for application in developed countries often take for granted (or rightfully assume) an existing strong base for supporting activities such as (1) measurement and calibration; (2) weights and measures control; (3) certification, including a national quality marks scheme, self certification programs of individual companies, etc.; (4) various programs of export inspection and testing; and (5) applied research for improved designs, materials, functions, tests, packaging, utilization, etc. These assumptions are in addition to that of an advanced system of standards development itself, as well as subsystems of quality control programs by suppliers of raw materials and components, quality control training programs, an active quality control society, professional and trade associations, etc. Countries with emerging industrialization programs simply do not have such a base of supporting activities and must include their development in overall national plans. These often become the initial or at least parallel tasks of standardization bodies, i.e., if recognized as essential and organized accordingly. It is, of course, possible to assign these tasks to agencies other than standardization bodies and in some cases this is highly desirable, especially if an infrastructure has been created for rationalization and coordination of the tasks. That is, a wider based effort is thus created.

For a comprehensive coverage of the principles of integrated standardization, the reader should consult the first three references and the following papers presented at UNIDO symposiums and workshops by Ettinger and Sittig [4], Evseenko [5], Gavin [6,7], Okamoto [8], Salama [9], and Koukhar [10].

4. NATIONAL CERTIFICATION PROGRAM

Also included in the above recommendations and part of integrated standardization is a national certification and quality mark program. A quality certification mark is a distinctive insignia that is placed on a manufactured product by a qualified producer. To qualify, a manufacturer in the country needs to obtain a license from the national or private body responsible for the certification scheme. The license can be withdrawn or other penalties can be imposed if the manufacturer fails to maintain the necessary minimum level with respect to pertinent quality specifications. One of the chief reasons national governments and individual companies promote certification programs is that they see it as a way to increase exports because buyers will preferentially purchase products with quality certification marks *provided the certification scheme is effective in ensuring a more consistent quality level and perhaps also a higher quality level* than would otherwise be the case.

Steps through which a company might in fact gain certification under a national program include a number of factory visits. The

initial visit is preceded by promotion and instruction in the procedure. Visits are made to the factory to review the company situation and to discuss the whole program with management. There is a factory visit to look at the actual operations, at the quality control situation, and at the organization for quality control. The laboratory is inspected which conducts tests associated with the quality of the product. Test records are examined, and the processes are observed by which the tests are carried out. Actual tests can be conducted, such as very simple viscosity tests on tooth paste, which can be done right on site by the team that is doing the inspection. Checks can be made to determine if the company itself is maintaining quality with respect to its own tests of the products. Random samples are selected from the product, either at the warehouse or directly from the production line, and are taken back to an independent laboratory, other than the company laboratory, for an independent check on the quality of the product, prior to issuing a license for the actual certification. Examples from the program developed in Thailand include a ballast factory, asbestos cement sheet fabrication, tooth paste production, and a fine silver shop. Two counterparts in Thailand have, through UNIDO fellowships, both received their masters degrees in quality control from the University of Birmingham in England.

The crowning glory of the process is when the quality mark license is issued and the local entrepreneur can be proud of displaying the quality mark. Ceremonies connected with the issuance of the license, promotion, and publicity with respect to the companies, help inform the public that there is such a program, and that quality is being achieved by local manufacturers, and that they should look for the quality mark in their purchases. This is a program which has had a lot of publicity to it, with coverage in the newspapers and TV and radio. Public exhibitions of products which bear the quality mark help to inform both the industrial public, who are potential customers for each other, and also the consumers, or the local public, about the quality mark and about goods which have been certified as meeting the quality mark.

Such programs have beneficial effects for local consumers. Some enlightening results were obtained in a recent British national survey of public awareness of quality marks. Among other things, 33% of the adults surveyed claimed that they looked for quality marks on products when shopping. Another 43% said they would look for quality marks if they knew more about the marks and what they represented about the assurance of quality. This indicates the strong influence which quality marks can have on consumers and domestic products.

Particularly when products are being exported, some independent third party, that is, some body other than the buyer or seller, can advantageously be involved in checking products to see that the quality of products meets certain specifications. Since, in a sense, the reputation of the country is at stake, it may well be in the best interest of the nation that a government or quasi-government organization act as this third body. The function of such an organization would be to ensure that outgoing products meet the required quality standards. A country might want to have two certification schemes, one for products sold nationally and one for exported goods, i.e., an export inspection program. Perhaps, a certification mark may be given to certain categories of products, which meet the required standards. Normally a mark can only be granted for a product for which a standard has been published. Customers, both local and foreign, can be educated by various means to understand the meaning of the mark and in this way be encouraged to buy goods with the certification mark in preference to others. Then, provided the certification program is good enough to ensure the quality of outgoing products, the reputation of the national mark will grow (and so likewise will that of the nation).

In Japan's rise to international recognition as a manufacturer of quality products, licenses to use the JIS (Japan Industrial Standard) quality mark have been issued to more than 10,000 factories. In 1949 the Industrial Standardization Law was established. One of the key characteristics of this law was the certification labeling system (the JIS mark). By law, through

statistical quality control audit, the Ministry of International Trade and Industry permitted manufacturers to put JIS certification marks on their products. This program, together with an extremely active supporting program of quality control education, implementation and public promotion, is credited with giving Japan a major thrust to industrial and economic prominence.

Historically, in the earlier developed industrialized countries, national certification mark programs proceeded (or are proceeding) from mature standardization efforts. It took (or is taking) many years to achieve the overall benefits of standardization together with the implementation of standards through a certification program. The developing countries have an excellent opportunity to shorten the period to achieve a significant degree of industrialization (of quality goods appreciated on the international and domestic markets) by simultaneously developing their standardization, certification, and quality control programs.

As mentioned above, in most industrialized countries, standardization has preceded certification, but in many developing countries certification is often the primary impetus for a standardization program. In these cases recognition of the value of standardization in its own right may be somewhat slow. Cultural and social factors may play a role in this regard. It is certification, with its statutory obligations or its more easily recognized commercial advantages, which will lead industry to an increasingly wider acceptance of standards.

One of the principal purposes of certification and quality marks programs in conjunction with standardization efforts, is to encourage and assist the manufacture of quality products -- a prelude to economic growth and stability. In this, the national standards body must recognize the importance and need for manufacturers to establish and/or maintain an adequate program of Quality Control and Assurance. In the preliminary investigation for the initial grant of license, as well as in the surveillance inspection and testing for continuance of the license, the National Standardization Body tries to determine if the factory has an adequate program of control of production so as to *assure continued conformity to the standard(s)*. Thus, in addition to the manufacturer's efforts, certification provides an independent, third party form of quality assurance.

In general, *certification is assurance by a competent organization, independent of trading interest, that goods are being manufactured in conformity with a standard*. However, it is not a guarantee! The quality of a manufactured product is *primarily the responsibility of the producer*.

Since it is economically impractical to provide for 100% assurance, a system has to be devised, product by product, which will provide the desired assurance within practicable and economic limits. This can be achieved under a system of quality control and assurance at the manufacturing plant, backed by regular inspections by an independent inspectorate and independently verified tests. In consonance with this principle, certification programs have the following objectives:

* Implementation of industrial standards with their many production benefits.

* Encouragement of quality manufacture, exports, and imports.

* Protection of the consumer from misrepresentation of product quality.

* Protection of the producer from improper competition.

* Reduction in the multiplicity of quality certificates (which reduces sampling, testing, time, and costs).

* Assistance to the producer's advertisement and marketing.

* Improvement in the quality of the Standards by locating errors and/or outmoded practices for feedback to technical committees or the Standards Council for revision of Standards.

5. QUALITY CONTROL - SOME BROADER ASPECTS

All of the activities of integrated standardization, and especially those of certification, are interrelated with quality control and contribute to improved quality of products and/or services. The statistical techniques of quality control and quality planning are useful in carrying out these activities. Yet something needs to be said here concerning the broader aspects of quality control and economic progress of developing countries. While statistical quality control is an essential part of a certification program, we must be careful that we are not lulled into thinking that certification is quality control. Especially in developing countries, there are at least three reasons why applications of quality control principles and techniques cannot be limited to a certification program. These are as follows:

1) Certification (as carried out in most developing countries) itself is an adjunct to a national standardization program. It is, therefore, limited to those products for which standards are prepared and published. Statistical Quality Control is not so limited. Standards preparation is also a relatively slow process. Then too (even without the usual limited resources), standards cannot be prepared on all products simultaneously - lower priority products are bound to be delayed. Furthermore, the application of statistical quality control to the manufacture of products, before or during the preparation of national standards on these products, can improve the standard by an inherent improvement in the quality of the products, and leads to direct cost reduction and increased orders for the manufacturers (as well as foreign exchange in the case of exports).

2) Not all products (processes, procedures, etc.) for which standards are prepared are suitable for certification. Yet statistical methods may be employed to improve and/or control these products, procedures, etc.

3) Manufacturers undergoing investigations for certification have a natural tendency to avoid discussion of quality problems on their products or processes. Whereas the crux of the matter on quality control investigations, assistance, and applications lies at high-lighting major problems and directing detailed study where it will count the most. Of course, test failures under certification have a similar effect. But it is possible for a manufacturer to obtain certification on his products (demonstrating conformity to the standard) while still plagued with relatively high internal scrap losses, excessive repair or rework, poor delivery, and other related ills. It is possible to miss the greatest benefits of Statistical Quality Control, if limiting quality efforts to a certification program alone.

6. TRAINING PROGRAMS ON QC METHODOLOGY AND MANAGEMENT

In the development of a comprehensive program of quality control, training cannot be over-emphasized. It has been and still is the key to unlock advances in quality and resultant manufacturing savings. It is the prerequisite to many other important quality control programs. In one U.S. factory of approximately 4000 employees, in which the author was employed, some 23,000 man hours of quality control training were conducted for personnel from top management to inspectors and key shop workers in a period of seven years. (And expanded to over 30,000 man hours over 12 years; see Stephens [11] for more details). This was during a concentrated period of process studies using quality control principles and techniques to control and obtain improvements on some 30 different products. More than 3,000 control charts were being used to achieve the results. Over this seven-year period, savings in production waste and excessive inspection amount to $27 million, against some $9.7 million in costs. Documentation of the results obtained on a number of specific products is contained in papers by Schin [12,13,14].

The above factory was visited by many Japanese industrial study teams in the mid-to-late 50's. Ishikawa [15] refers to his visit to this factory in 1958 on page 7 of the referenced paper. The importance of training in Japan's rise to international fame in quality manufacture is summarized in several papers, see for example,

Ishikawa [16,17], Higashi [18], Koyanagi [19], Miura [20], Mizuno [21], Juran [22], Deming [23,24]. It is estimated that the total number of participants in the education courses outside companies reached more than 100,000 for the period from 1949 to 1968. With the in-company training programs, several million have been trained. In more than 2,000 companies, training has been completed for all employees including top management and workers. The Japanese Standards Association, since 1953, has been conducting seminars on quality control and standardization. Every year the Association held 17 seminars of about 160 hours' duration each. Above 1100 attendants were trained in 1972 and more than 18,000 in total. Identified at the UNIDO-Athens First International Symposium on Industrial Development in 1967 as the main difficulty in establishing quality control programs in developing countries was the problem of training and education. This is still true today, generally. And since its establishment, UNIDO has been providing extensive technical assistance, including training programs. See Stephens [25]. Other international organizations such as APO and ISO have contributed along with numerous bi-lateral efforts.

One training format which has been used successfully on a number of occasions and locations is the following. After attending lectures and participating in workshop sessions for a number of weeks (between one and four, depending on the course), participants are then required to return to their regular jobs, apply what they have learned, prepare a report on one or more of such applications, submit the report to the training staff, and finally reassemble with the other participants for a final workshop discussion of their experiences in applying the techniques they have learned. It is only after satisfactorily completing all these things that a participant is considered a graduate of the course and awarded a certificate. This program has been used in India, Ott et. al [26], and Ott [27]; in Singapore, Hunter et. al [28], and more recently in Nigeria, Stephens [29].

The workshops in Nigeria are always opened by a Minister. After the basic introduction of quality control techniques and principles, we carry the program right out to the factory, where the problems are. We consult with them, and we also train the local staff, in this case the staff of the Nigeria Standards Organization, in how to carry out factory consultations and training. The workshop is always capped by a ceremony to present certificates, which are always given out by one of the State Ministers. So far, we have conducted this type of program in six of the cities of Nigeria.

Properly planned and conducted, such a program has the following potential benefits: (1) initial training in the basics of statistical quality control/quality assurance for a selected group of industrial personnel, (2) the beginning of applications of the principles and techniques directly in the factories of the participants and the resultant "real world" exposure, (3) exposure of staff from local organizations to methods of instructions and industrial consultation to enable them to carry on the program (preferably in the local language for additional groups of foreman, etc., not necessarily proficient in English).

In an industrial consulting situation, the above program has the feature of superimposing a training effort on top of the consulting program alone -- with the added ingredient of directing the participant himself to seek the improvements. The training effort is two-fold -- initial training of the industrial participants and advanced training of the indigenous staff.

7. QUALITY CONTROL PROMOTION

Another of the earlier recommendations is that of developing a program of public awareness of quality. This includes programs to promote quality control, educate consumers, involve and motivate worker participation in quality improvement, etc. Two programs with a wide-spread application and literature, namely "Zero Defects" and "QC Circles" are discussed separately. More general national programs of public awareness are presented first in the following subsection.

7.1 General Promotional Programs

Ishikawa [17] outlines use of public media in Japan's efforts to educate her people and promote quality control as follows:

"7) QC education for foremen through broadcasting were held between 1956-1962. QC course through radio began in July, 1956. The Nippon Shortwave Broadcasting Co. (NSB) held three month course seven times. Since 1957, NHK (Japan Broadcasting Corporation) held an intoductory course called 'management and quality control' for seven weeks (15 minutes per weekday). More than 100,000 copies of this textbook have been distributed. From 1957 to 1962, there were seven NHK radio QC courses. In 1960 and 1961 NHK TV broadcast two courses called 'Quality Control and Standardization' for four months.

"9) 'National Quality Month' started in 1960, which are held under the co-sponsorship of JUSE, JSA (Japanese Standards Association) and other organizations, and since then it has been observed every November. The 'Q' mark and 'Q' flag were decided."*

Singapore launched a program called PQR (Prosperity for all through Quality and Reliability) on 23 February 1973 after a call for such a program by the Finance Minister in June 1972. Highlights of the PQR Campaign activities included:

- "Training courses for workers at all levels on quality control concepts and techniques.
- Essay competition for pre-University school students.
- A science and industry quiz for secondary schools.
- Worker-of-the-month competitions in factories participating in the campaign.
- A national PQR stamp selection contest.
- Issue of a set of four PQR Commemorative stamps.
- Public lectures and talks on Quality and Reliability to manufacturers and workers.
- Distribution of PQR flags and posters to participating organizations.
- Presentation of worker-of-the-month certificates and awards to deserving workers.
- Awards of citations to companies active in promoting PQR ideals.

"These activities, carried out over a six-month period, involved some 70,000 workers, 146 schools, 300 companies, government ministries, and organizations like the Consumers Association of Singapore and the Singapore Quality and Reliability Association.

"In a nutshell, a whole nation was involved in the PQR Campaign."*

Features of the campaign are summarized in the following forward by the Chairman of SISIR and Chairman of the PQR Campaign Organizing Committee, Dr. Lee Kum Tatt, in the brochure, "PQR ... a way of life."*

"This publication is dedicated to the 70,000 workers and the 300 companies who participated in the PQR Campaign. It is also a tribute to the various organizations -- the National Trades Union Congress, the Singapore Manufacturers' Association, the Singapore Institute of Standards and Industrial Research (SISR), the government bodies and the Consumers' Association of Singapore for working together and planning the numerous activities and programs that took place during the Campaign.

"The spirit and mood of the PQR Campaign is captured in print and in pictures in this publication. It is hoped that this will serve as a record to those that come after us that when national tasks are at stake, sectorial differences can be subdued and

* Ishikawa [17], page 423

* SISIR [30], pages 20 and 21

replaced with a common goal. That goal was, and still is, Prosperity for all through Quality and Reliability.

"Companies who are featured have contributed towards the cost of this publication. They represent a cross section of the Republic's industries, subscribing and working towards the PQR ideals.

"As you read through these pages, you may discover that the PQR Campaign is much more than simply a tripartite parternship between the workers, manufacturers and the Government. It is an integration, a melding of modern quality control concepts and social obligations and responsibilities, into a national way of life.

"With continued dedication and understanding -- and above all, with proper encouragement and support by the public -- the Q and R movement is likely to provide significant results in meeting the increasing demands of the public for entirely new and higher levels of quality products and services. Internationally, it should reinforce the image that Singapore is a manufacturing nation of quality goods and that PQR activities never cease in Singapore."*

The Republic of Korea has also launched a Quality Control Campaign. It was reported on by Dr. Jong Wan Choi [31] at the 1976 Annual Technical Conference of the ASQC in Toronto, June 7, 1976. The following excerpts from his paper describe the background and program and need no further amplification.

"Brief Historical Background of Quality Control Development

"Now let us turn to the historical background of recent quality control developments in Korea.

"In 1961 the Government established the Industrial Standardization Law. This was followed in 1963 by the adopting of the Korean Standards marking system. Many leading Korean industries began their Quality Control activities as a result of these Government initiatives.

"Since the K.S. Marking System was put into force in 1963, a total of 249 commercial products have been allowed to display this mark. The number of factories producing K.S. Mark products now stands at 338.

"Before the 1961 law very few industries in Korea had any serious concern for quality control. It was a seller's market. The economy was in rapid transition from pre-modern to modern, and the manufacturers concentrated on increasing production and starting new operations. Consumers received little attention and competition was minimal.

"In due time, however, as her exports increased, Korean industry ran into stiff foreign competition. At the same time, domestic consumers were becoming more sophisticated, and competition on the local market gained more attention. The situation for Korean industry was changing rapidly, and the need for quality control became clear.

"Since 1973 the oil crisis and worldwide recession have served as further forces accelerating changes in Korean business practices. Modern management techniques, quality control and energy management have been emphasized."

"Quality Control Campaign in Korea

"Last year the Korean Government, through its Ministry of Commerce and Industry, launched a Nation-wide Quality Control Campaign.

"The Campaign headquarters is placed in the Industrial Advancement Administration (IAA).

"I, who happen to be the first administrator of IAA, am responsible for making overall policies, coordinating between various implementing activities and evaluating and assessing campaign results for the quality control campaign with advice and recommendations from the advisory boards, which consist of related government agencies, various economic and industrial organizations and trade associations.

"The Korean Standards Association is designated and authorized as the Secretariat Bureau for the campaign. This means that although the national campaign is under government leadership, its actual

* SISIR [30], page 3

implementation is the responsibility of the Korean Standards Association.

"To kick off the campaign and create awareness of the importance of a QC system in industry, the campaign committee conducted massive public relations activities through speeches, seminars and various public meetings utilizing public media and distributing leaflets, pamphlets, manuals and other printed materials.

"The campaign has two main directions. In the first facet the government designated companies which are to carry out QC improvement programs. The companies which have been designated so far are large and high level industries, including export manufacturers.

"In 1975 the government designated 500 industries, and this year the number designated will reach 1000. Companies accept this designation with pride and respond with a sense of duty.

"For each designated company, the improvement program includes the following:

1) establishing a company-wide QC system
2) improving company standardization
3) employing QC specialists
4) organizing QC circle activities
5) developing on-the-job training programs
6) holding company conferences and contests on QC activities
7) participating in specialized seminars

"The second facet of the campaign is a national awards program for companies and QC circles which make exceptional progress in the improvement program just described. At the industry level, outstanding companies submit applications to the awards committee of the national QC campaign administration. Inspection teams then visit each applicant firm and prepare recommendations for the award committee. One first prize and a few second prizes are awarded.

"In the case of QC circles, competition takes place first within an individual company then moves on to a local contest and finally reaches the national level. There are a few gold medals and several secondary awards for the competition. The highlight of last year's QC movement was the nationwide QC Convention held at the National Theater on October 30. Participants included some 1,500 QC-related officials and members of the companies and especially the Prime Minister, who personally led the whole convention. Exemplary QC circles and enterprises were cited at the ceremony, and special lectures were given by such world renowned QC specialists as Dr. W. Edwards Deming of the U.S.A. and Dr. Mizuno of Japan.

"As you can see, the Nation-wide Campaign and other factors I have mentioned have given a big push to our QC progress in Korea. But the active government involvement such as I have been describing is only temporary. Over the long range, we realize, the responsibility must come to rest with individual enterprises. It will be up to industry to keep the ball rolling. This process has already begun, but maintaining momentum is always a problem."*

7.2 Zero Defects Program

Zero defects had its beginning back in 1961-1962, when the Martin Company of Orlando, Florida delivered a Pershing Missile with zero discrepancies to Cape Canaveral. Shortly after this, Brigadier General R. W. Hurst, then deputy commander of the United States Army Missile Command requested the delivery of a Pershing Missile one month earlier than scheduled. The Martin Company accepted this challenge and transmitted it to the Pershing team. The reply transmitted was that the delivery would be made in February and with zero discrepancies. (This was transmitted down to the quality inspectors.) When this was accomplished, the idea of zero discrepancies was passed down to the employees. The result was the inception of the Zero Defects program.

Basically, the objective of this program is to place emphasis on the importance of the employee's effort continually to do error-free work. The program must be well

*Choi [31], pages 3-6

planned and carefully organized to give the best results from top management on down to the individual employee (i.e., top management must indoctrinate and motivate mid-management; mid-management must do the same for supervisors; etc.). This indoctrination and motivation toward zero defects is accomplished by the use of a kickoff campaign. Included in the campaign are rallies, posters, pins, slogan contests, etc. After the kickoff of the program, each employee is asked to sign the Zero Defects pledge; they are not required to sign, but only asked for a voluntary effort. The whole program is aimed at motivating the employee to do his best because he wants to, not because he has been coerced.

Motivation of an employee to do his best must begin with management. The management team must be sold on the zero defects program before they can attempt to motivate their employees into accepting the zero defects program. For the program to be a success, the employees must thoroughly believe in the program. This is achieved by convincing the employee of the importance of his job. This is not done by congratulations or patting the employee on the back. The worker must be shown and convinced by actions and examples that his job--any job--is worth doing well. Only then will he see any reason to make the effort that Zero Defect performance requires.

The maintenance of a Zero Defects program requires that specific detection, monitoring, and correction techniques be given to operators and their supervisors. Each case of non-conformance to specifications represents a challenge to someone; if he knows he can identify the specific causes of such defects, the worker or supervisor is motivated to do it year after year. (See American Management Association [32].) Thus, the Zero Defects program is aimed at keeping the employee doing his best, time and time again.

The Zero Defects program itself is actually a method of quality assurance through prevention rather than detection. Emphasis is placed on preventing defects during the production process instead of correcting defects after the item is produced. In order to achieve this, a good deal of money is put into the prevention techniques of quality control. In most companies, many man-hours are spent keeping records, analyzing costs, and developing statistics so they can better tell how much to add to their cost proposals and project plans to cover losses due to discrepancies (See Halpin [33].) Many companies can cut quality costs if, in the beginning, they had put their money into a prevention program instead of an after the fact quality program. In the long run, the Zero Defects (prevention) program will turn out to be actually cheaper than a detection program. However, aside from costs, the Zero Defects program has other benefits:

1. Improvement in attitude and in employee morale.
2. Development of better communication between employee and supervisor, therefore, there is a better teamwork, more group spirit, and an all-around improvement in working relationships.

A definition of the Zero Defects Program as given by James F. Halpin [33] is "Zero Defects is simply a method of assuring that each individual within an organization realizes his importance to that organization's product or services and, conversely, that each member of management realizes and recognizes the important contribution of each person reporting to him."*

Several companies have reported on ZD programs. See for example, Crosby [34], Pierce and Streep [35], Halpin [36], Haas [37], Riordan [38], Sharpe [39], Wood [40], Dallas [41], Shove [42], Berndt [43], and papers in Textile World [44], Coal Age [45], Iron Age [46], and Quality Management and Engineering [47].

There is also the misuse or perhaps the misrepresentation of credit to ZD programs for results obtained. One serious danger is an attempt to achieve results by motivational techniques alone, not backed by the recognition of common causes of defects with management responsibility and statistical and engineering tools. Juran [49] examines the ZD movement and the concept of motivation. The author presents a brief critique of a

* Halpin [33], page vii - preface

paper by Gregory [49] in a letter to the editor which was published in the October-December 1973, International Trade Forum, Volume IX, number 4, on page 37. Sandholm [50] also presents some cautions in his paper and mentions a motivational program in the USSR referred to as the "Saratov method".

Zero Defects programs have been used in developing countries. The author has had the privilege of some exposure to the use of Zero Defects by the Teajon Leather Company in Taejon, South Korea. The program involves some 30 member affiliates. A Zero Defects newspaper is published and circulated among the members to create attention to improvements, and accomplishments as well as problems. It is worth consideration by developing countries, especially in light of the present thinking as to the necessary complementary programs and features.

7.3 QC Circles

Perhaps no other single quality control concept has been lauded more in the phenomenal growth of Japan's industrial post war than that of the QC Circle. See Modern Manufacturing [51], March 1970.

Five principal references contain a great deal of background material and explanation of the QC Circle idea and program. These are (1) QC in Japan Series No. 1, QC Circle Activities, JSUE, 1968, edited by Kaoru Ishikawa, (2) Reports of QC Circle Activities, Nos. 1-8, 1968 to 1975 (a number of these are out of print), (3) Proceedings of the International Conference on Quality Control, 1969, Tokyo, (4) Guide to Quality Control Circle Activities, Asian Productivity Organization, No. 24, April 1971, (5) Japan Quality Control Circles, Asian Productivity Organization, 1972.

With respect to the birth, early development objectives and activities of QC Circles, the first reference above should be consulted, see Ishikawa [16], pages 16-18.

QC Circle activities have been reported by Kao [52] in the Republic of China and by Choi [31] in Korea. Some preliminary papers and an entire workshop session on QC Circles were held at the 1976 ASQC Annual Technical Conference in Toronto, Canada. See papers by Amsden D. [53], Blakely [54], Beardsley [55], Rehg [56], Rieker [57], Dewar [58], and Amsden, R. [59]. This is a continuation of such workshops and exchanges between the U.S. and Japan. See for example, Rubenstein [60]. And these programs continue and expand annually. See Beardsley and Dewar [61].

8. ELEMENTS OF A QUALITY SYSTEM

To serve as a guideline in the development of an overall quality system, the following is a listing of some elements that should be taken into consideration. It is presented primarily in outline form for brevity. Further details on each of these areas are available in various publications and can be consulted and studied for implementation. (Many are included in the reference section.) The degree to which these elements are included and integrated within the business structures will vary by size and type. However, these activities and programs can be organized and carried out by a single entrepeneur as owner-operator of a business, by managers (owners) of small to medium businesses or by management-technical teams of large businesses. Emphasis is on the functions rather than the organization or individuals that carry out the functions.

I. Planning, Organization and Administration
   - A. Quality Policy
   - B. Organization
   - C. Quality Control System Manual
   - D. Quality Assurance -- System Monitoring, Review, and Audit
   - E. Quality Cost Data
     1. Prevention Costs
     2. Appraisal Costs
     3. Internal Failure Costs
     4. External Failure Costs
     5. Life Cycle Costs
     6. Value Analysis
     7. Management Reporting

II. Product Design, Planning, Specification Development, and Control
   - A. Design Review on New or Redesigned Products and Services
   - B. Acceptance/Rejection Criteria for All Inspections and Tests

C. System to Qualify New or Redesigned Products, Processes, or Services
D. Documented Authorizations
E. Safety, Regulatory Requirement Assurance
F. Control of Design or Processing Changes

III. Control of Purchased Materials and Component Parts
A. Communication of Requirements to Suppliers
B. Selecting Qualified Sources
C. Determining Supplier Capability -- Evaluation and Rating of Suppliers
D. Vendor-Vendee Relations -- Utilizing Supplier Quality Evidence
E. Nonconformance Control and Corrective Action
F. System of Inspection and Test
G. Instrument Calibration and Maintenance
H. Stock Control -- Quantity and Quality

IV. Manufacturing Quality Control
A. Planning and Controlling the Process
1. Materials Control
2. Production Operations Control
3. In-Process Inspection
4. Nonconforming Material Control
5. Employee Selection, Training, and Motivation (see VII)
B. Final Inspection
1. Acceptance Sampling
2. Product Quality Audit
3. Performance Testing
4. Environmental, Life, Reliability, and Safety Testing
C. Test Equipment, Tools, and Gages
D. Handling, Storage, and Shipping
E. Product and Carton Identification (Labeling)
F. Quality Information
1. Production Reports
2. Quality Reports -- Scrap and Spoilage Reports
3. Inspection Reports
4. Cost Reports

V. Customer Contact and Field Performance
A. Marketing
1. Market Research
2. Advertising and Promotion
3. Sales/Service
4. Application Engineering
B. Product Development
C. User/Consumer Feedback
1. Product Return and Failure Analysis
2. Customer Complaints
D. External Feedback (Government, Trade Associations, etc.)

VI. Corrective Action
A. Need for Corrective Action
1. Routine Inspection and Test
2. Customer Complaints
3. Product Service Calls Analysis
4. Warranty Claims Analysis
B. Application of Corrective Action
1. Product
2. Process
3. People

VII. Employee Selection, Training, and Motivation
A. Policy for Employee Quality Performance
B. Company Work Rules
C. Product and Process Design for Employee Quality Performance
D. Employee Job Standards
E. Job Training
F. Employee Motivation Programs
1. Zero Defects
2. Q.C. Circles and/or Participative Quality Control
G. Employee Job Supervision
H. Surveillance and Audit
I. Wage and Salary Administration

VIII. Sampling and Other Statistical Techniques
A. Acceptance Sampling
1. Attribute and Variable (MIL STD 105D, MIL STD 414)
2. Lot by Lot, Batch, Continuous (Dodge-Romig Tables, CSP)
3. Miscellaneous Plans (Narrow Limit Gauging, ChSP, Skip Lot, etc.)
B. Process Control Charts
1. Attribute Charts (p and np, c and u charts)
2. Variables Charts ($\bar{X}$ and R, M and R, $\tilde{X}$ and R, Cum Sum Charts)
3. Acceptance Control Charts
C. Special Studies and Experimental Design Techniques

1. Designed Experiments
2. Error of Measurement
3. Evolutionary Operation

IX. Legal Requirements/Product Liability/User Safety
A. Mandatory Standards and Regulation (CPSC, FDA, etc.)
B. Safety and Environment (OSHA, EPA)
C. Insurance Coverage
D. Product Certification Program

9. CONCLUSION

In summary, we have found through experience, that Quality, and its related disciplines of quality control, quality assurance, standardization, certification, and the whole approach to integrated standardization, have been very successful in allowing many countries, including the developed countries and those that are fast reaching that threshold, to gain the progress that they have made. It certainly is recommended as a very important element in the national development of any country, to put Quality and these related disciplines in the proper perspective, and to give them a proper priority in planning and in implementation.

REFERENCES

[1] Stephens, K. S., Preparing for standardization, certification and quality control (Asian Productivity Organization, in preparation).

[2] Juran, J. M., Standardization and quality, Quality Progress, VII, No. 2, 4-5 (Feb. 1975).

[3] The role of standardization in economic development, Proc. of an ISO Conference, Mexico City, Sept. 1973 (International Organization for Standardization, Geneva, Switzerland, 1973).

[4] Ettinger, J. van, and Sittig, J., Quality control and standardization as conditions of industrial growth, ID/CONF.1/G.4, 12 June 1967, UNIDO, International Symposium on Industrial Development, Athens, 29 November - 20 December, 1967.

[5] Evseenko, E. S., Standardization and quality control the key factors to advance the developing countries to technical progress, ID/WG.61/DP/10, 16 September 1970, UNIDO, Seminar on the Organization and Administration of Industrial Services (for Asia and the Middle East), Tashkent, USSR, 12-26, October, 1970.

[6] Gavin, J. M. L., Standards, quality assurance and the internal market, ID/WG.71/8, 15 October 1970, UNIDO, Training Workshop for Personnel Engaged in Standardization, Addis Ababa, Ethiopa, 17-24 November, 1970.

[7] Gavin, J. M. L., Standards, quality control and certification compliance marking and the consumer, ID/WG.97/3, 14 July 1971, UNIDO, Training Workshop for Personnel Engaged in Standardization, Santiago, Chile, 27 September - 5 October 1971.

[8] Okamoto, Y., Relationship between quality control, standardization, and metrology and concepts of metrology services, ID/WG.98/5, 4 August 1971, UNIDO, Training Workshop on Metrology, Nagoya, Japan, 12-23 October, 1971.

[9] Salama, M., Aspects of regional cooperation in quality control activities, ID/WG.100/4, 16 September 1971, UNIDO, Training Workshop in Quality Control, Cairo (UAR), 30 November - 9 December, 1971.

[10] Koukhar, V., Quality and standardization, ID/WG.100/5, 16 September 1971, UNIDO, Training Workshop in Quality Control, Cairo (UAR), 30 November - 9 December, 1971.

[11] Stephens, K. S., Quality control - small and large, Transactions of the 1st Pan American Congress on Quality Control and Statistics in Industry, Mexico City, May 12, 1965, and Proc. of the Quality Control Conference, US

Dept. of Commerce, Bur. of Public Roads, Washington, D.C., April 6, 1965.

[12] Schin, R., Can quality control pay its own way?, Transactions of the Rutgers All-Day Quality Control Conference, Rutgers, The State University of New Jersey, New Brunswick, New Jersey, September 12, 1959, pp. 107-125.

[13] Schin, R., Process control is essential for reliability of electron devices, Transactions of the Metropolitan Conference on Quality Control, New York, Feb. 26-27, 1960, pp. 158-167.

[14] Schin, R., Quality control engineering - in process and product control, Industrial Quality Control, XVI, No. 10 (April 1960).

[15] Ishikawa, K., et. al, Quality control activities of foreign countries through Japanese eyes, Reports of Statistical Applications Research, Union of Japanese Scientists and Engineers (JUSE), 22, No. 2, June 1975, pp. 3-17, 5-10-11 Sendagaya, Shibuhaku, Tokyo.

[16] Ishikawa, K. (Editor), Q.C. circle activities, QC in Japan Series No. 1, Union of Japanese Scientists and Engineers (JUSE), Tokyo, April 1968.

[17] Ishikawa, K., Education and training of quality control in Japanese industry, Proc. of the International Congress on Quality Control, Tokyo, Oct. 1969, pp. 423-426.

[18] Higashi, H., Quality control in Japanese small scale manufacturers, Proc. of the International Congress on Quality Control, Tokyo, Oct. 1969, pp. 485-488.

[19] Koyonagi, K., Statistical control of quality in Japanese industry, a brief report submitted to the 1952 American Society for Quality Control meeting in Rochester, published by JUSE, Tokyo 1952.

[20] Miura, S., Japan's role in quality control education and training through the channel of economic cooperation, Proc. of the International Congress on Quality Control, Tokyo, Oct. 1969, pp. 741-744.

[21] Mizuno, S., Company-wide quality control activities in Japan, Proc. of the International Congress on Quality Control, Tokyo, Oct. 1969, pp. 21-24.

[22] Juran, J. M., Development of QC in Japan, 1954-1974, Reports of Statistical Applications Research, Union of Japanese Scientists and Engineers (JUSE), 22, No. 2 (June 1975).

[23] Deming, W. E., My view of quality control in Japan, Reports of Statistical Applications Research, Union of Japanese Scientists and Engineers (JUSE), 22, No. 2, 25-32 (June 1975).

[24] Deming, W. E., Statistical control of quality in Japan, Proc. of the International Congress on Quality Control, Tokyo, Oct. 1969, pp. 367-370.

[25] Stephens, K. S., UNIDO technical assistance in standardization, certification and quality control -- with a Thailand case study, International Conference on Quality Control, Tokyo, 1978.

[26] Ott, E. R., Andrews, H. P., Gore, W. L., and Stephens, K. S., Statistical quality control an aid in industrial development, Final Report to the Government of India of experts appointed under the United Nations Technical Assistance Program, Commissioner for Technical Assistance, June 15, 1963.

[27] Ott, E. R., The national development of industrial applications of quality control, Proc. of the International Congress on Quality Control, Oct. 1969, pp. 737-739.

[28] Hunter, W. G., Stephens, K. S., and Chacko, E., Creating effective national programs in developing countries for standardization, certification, and quality control, ITCC Review, Tel Aviv (1974).

[29] Stephens, K. S., Certification mark and quality control program for the Nigerian Standards Organization, Technical Report 1, NIR/75/070, UNIDO, Vienna, 18 November, 1977.

[30] Singapore Institute for Standards and Industrial Research (SISIR), PQR...a Way of Life (published by PQR Campaign Organizing Committee, Singapore, 1974).

[31] Choi, J. W., Quality control campaign in Korea, Paper presented to 30th Annual Technical Conference, ASQC, Toronto, June 7-9, 1976.

[32] American Management Association, Zero defects - doing it right the first time, Management Bulletin, 71 (1965).

[33] Halpin, J. F., Zero Defects - A New Dimension in Quality Assurance (McGraw Hill Co., 1966).

[34] Crosby, P. B., Z is for zero defects, Industrial Quality Control, 182-185 (Oct. 1964).

[35] Pierce, R. J. and Streep, S. C., Successful, motivational programs, Industrial Quality Control, 654-658 (June 1966).

[36] Halpin, J. F., Zero defects in retrospect, Industrial Quality Control, 669-670, 681-682 (June 1966).

[37] Haas, A. R., The superior craftsman program, Industrial Quality Control, 665-669 (June 1966).

[38] Riordan, J. J., Quality and reliability assurance management in the Department of Defense, Industrial Quality Control, 662-665 (June 1966).

[39] Sharpe, M. R., Manned flight awareness - zero defects for man-rated space vehicles, Industrial Quality Control, 658-661 (June 1966).

[40] Wood, W. P., Zero defects; it pays, Mechanical Engineering, 88, 45-47 (Nov. 1966); Naval Engineering Journal, 79, 293-296 (April 1967).

[41] Dallas, D. B., Zero defects bandwagon, Tool and Manufacturing Engineering, 56, 62-65 (Jan. 1966).

[42] Shove, R. J., Lessons of a zero defects campaign, Naval Engineering Journal, 79, 972-976 (Dec. 1967).

[43] Berndt, R. E., Zero defects programs give safety a lift, Safety Maintenance, 135, 13-14 (Feb. 1968).

[44] Zero defects; Burlington-Balfour finds major savings by raising quality goal from 90 to 100%, Textile World, 116, 50-55 (Nov. 1966).

[45] Zero defects concept: modern way of achieving top-notch quality control, Coal Age, 70, 112 (Nov. 1965).

[46] Zero defects down to the wire, Iron Age, 199, 83 (June 15, 1967).

[47] The quality world of ITT, Quality Management and Engineering (Jan. 1975).

[48] Juran, J. M., Quality problems, remedies and nostrums, Industrial Quality Control, 647-653 (June 1966).

[49] Gregory, G., Zero defects - Japan's quest for quality, International Trade Forum, IX, No. 1, 14-17 (Jan.-March 1973).

[50] Sandholm, L., Quality, quality motivation, reliability, and the consumer, ID/WG. 100/10, 13 October, 1971, UNIDO, Training Workshop in Quality Control, Cairo (UAR), 30 November, 9 Dec. 1971.

[51] The secret of Japan's rise to quality fame, Modern Manufacturing, 66-68 (March 1970).

[52] Kao, S. C., National quality control in the Republic of China, Proc. of the International Congress on Quality Control, Tokyo, Oct. 1969, pp. 813-816.

[53] Amsden, D., QC circles: a challenge to ASQC, 30th Annual Technical Conference Transactions, ASQC, Toronto, June 7-9, 1976, pp. 224-228.

[54] Blakely, E. D., and Amsden, D., QC circle workshop: Pareto analysis, 30th Annual Technical Conference Transactions, ASQC, Toronto, June 7-9, 1976, pp. 236-243.

[55] Beardsley, J. F., Training is the heart of the Lockheed QC circle program, 30th Annual Technical Conference Transactions, ASQC, Toronto, June 7-9, 1976, pp. 257-260.

[56] Regh, V., QC circle workshop: application, 30th Annual Technical Conference Transactions, ASQC, Toronto, June 7-9, 1976, pp. 229-235.

[57] Rieker, W. S., What is the Lockheed quality control circle program?, 30th Annual Technical Conference Transactions, ASQC, Toronto, June 7-9, 1976, pp. 253-256.

[58] Dewar, D. L., Measurement of results - Lockheed QC circles, 30th Annual Technical Conference Transactions, ASQC, Toronto, June 7-9, 1976, pp. 249-252.

[59] Amsden, R., Beardsley, J., and Rehg, V., QC circle workshop: cause and effect diagrams, a most useful tool, 30th Annual Technical Conference Transactions, ASQC, Toronto, June 7-9, 1976, pp. 244-248.

[60] Rubinstein, S. P., Participative quality control, Quality Progress, 24 (Jan. 1971).

[61] Beardsley, J. F., and Dewar, D. L., Quality Circles (Quality Circles Ltd., San Jose, Calif., 1978).

The following references are a continuation of the literature associated with the paper though not specifically referenced. Numbering is for continuity and identification purposes.

[62] Deming, W. E., What happened in Japan , Industrial Quality Control, 24, No. 2, 89-93 (August 1967).

[63] Deming, W. E., Some statistical logic in the management of quality, Proc. of the All India Congress on Quality Control, New Delhi, March 1971, pp. 98-119.

[64] Feiganbaum, A. V., Total Quality Control: Engineering and Management (McGraw Hill Book Co., 1961).

[65] Juran, J. M. (ed.), Quality Control Handbook (McGraw Hill Book Co., New York, 3rd edition, 1975).

[66] Juran, J. M., and Gryna, F., Quality Planning and Analysis (McGraw Hill Book Co., New York, 1970).

[67] Burr, I. W., Statistical Quality Control Methods (Marcel Dekker, Inc., New York, 1976).

[68] Caplen, R. H., A Practical Approach to Quality Control (Business Books Limited, London, Second edition, 1972).

[69] Dodge, H. F., and Romig, H. G., Sampling Inspection Tables - Single and Double Sampling (John Wiley and Sons, Inc., New York, 2nd ed., 1959).

[70] Duncan, A. J., Quality Control and Industrial Statistics (Richard D. Irwin, Inc., 4th ed., 1974).

[71] Grant, E. L., and Leavenworth, R. S., Statistical Quality Control (McGraw Hill Book Co., New York, 4th ed., 1972).

[72] Harris, D. H., and Chaney, F. B., Human Factors in Quality Assurance (John Wiley and Sons, Inc., New York, 1969).

[73] Hopper, A. G., Basic Statistical Quality Control (McGraw Hill, London, 1969).

[74] Japan Quality Control Circles (Asian Productivity Organization, Tokyo, 1972).

[75] Ott, E. R., Process Quality Control (McGraw Hill Book Co., 1975).

[76] Simmons, D. A., Practical Quality Control (Addison-Wesley Pub. Co., Reading, Mass., 1970).

[77] Statistical Quality Control Handbook (Western Electric Co. Inc., Mack Printing Co., Easton, Pa., 1964).

[78] Thomas, L. F., The Control of Quality (Thames and Hudson, London, 1965).

[79] ASTM Manual on Quality Control of Materials (American Society for Testing Materials, Philadelphia, Jan. 1951).

[80] Peason, E. S., The Application of Statistical Methods to Industrial Standardization and Quality Control, British Standard 600:1935.

[81] Building a quality movement. Techniques designed for developing countries suggest broad applications, Quality Progress, 35-38 (August 1972).

[82] Tinkham, M. L., Quality control movement stirs in Singapore, Quality Progress, 38-40 (August 1972).

[83] DeFremery, J. D. N., Still underdeveloped aspects of Q and R, Paper presented at the National Conference, Verwaltung der Qualitat, Sofia, Bulgaria, 14-17 Nov. 1972.

[84] Lancaster, E. J., International quality activity, Quality Progress, 14-15 (August 1973).

[85] Stephens, K. S., Quality and Quality Control, Productivity Series No. 11 (Asian Productivity Organization, Tokyo, 1976).

[86] Stephens, K. S., Thailand's certification and quality marks programme, 29th Annual Technical Conference Transactions, ASQC, San Diego, May 12-14, 1975, pp. 345-356 and Quality, EOQC Journal, XIX, No. 2, 52-58 (Summer 1975).

[87] Hopper, R., and Stephens, K. S., Standards and certification in a developing country, BSI News, 8-9 (April 1973).

[88] Sheffer, D. (translator), Quality Control in a Developing Economy, A Case Study of Israel (The Centre for Policy Studies, Keter Publishing House, Jerusalem, 1970).

[89] Ishikawa, K., Guide to Quality Control (Asian Productivity Organization, Tokyo, 1972).

[90] Sandholm, L., United Nations training programs in quality control, Quality, Journal of the European Organization for Quality Control, XX, No. 2, 8-11 (1976).

[91] United Nations Industrial Development Organization, Guides to Information Sources No. 6, Information Sources in Industrial Quality Control (United Nations, New York, 1973) (available from UNIDO, P.O. Box 707, A-1011, Vienna Austria).

DISCUSSION:

Dr. Edward L. Brady (NBS):

Is there a continuing UN program in Nigeria?

Dr. Stephens:

Nigeria has one of the largest UN country programs in the world. This specific project runs through 1980; additional workshops are scheduled for both 1979 and 1980. There is an adviser right now in Nigeria, advising the Nigerian Standards Organization on the selection of test equipment for the eventual national testing laboratories. A site has been selected by the Nigerian Government for the construction of a national laboratory for

product testing and metrology. Once that building is finished and some of that equipment is brought in, then there will be three long-term advisers that will come out in areas of chemical analysis, product testing, and metrology, each for a one year period.

Mr. Radway:

It seems pretty clear from your presentation that there is a direct correlation between the system of quality control and the effective transfer of technology. Is UNIDO communicating this simple fact to the various developing countries? What I have in mind is the fact that certain developing countries at this moment have laws prohibiting the transferor of technology from imposing quality control systems and standards, in the license agreement or the technology transfer agreement. In those situations where that exists, is there some way of communicating this kind of information to the technocrats in those countries, so that they can internally contribute to the dialogue that is going on within the country?

Dr. Stephens:

I am sure there is. UNIDO does provide, periodically, regional seminars on this subject. I personally agree with you that this whole effort could be planned with respect to disseminating the experiences of other countries and the benefits that have resulted from efforts in standardization and its full integrated approach, including certification programs, quality control, metrology, export inspection, and applied research in all those areas. However, one of the philosophies under which UNIDO operates, by way of its policy and charter, is that it protects the sovereignty of every nation. It does not impose anything on a nation that that nation does not itself desire. All UNIDO projects must be requested. UNIDO provides certain instruction, advice, and assistance in the creation of projects or may propose that certain countries might benefit from certain programs. But in the bottom line, the request must originate from the country, and of course be approved by that country.

Mr. Frank Lancetti (Office of the U.S. Coordinator for UNCSTD, Dept. of State):

To establish a connection between what has been said and the UN Conference on Science and Technology, note that UNIDO is one of the three United Nations specialized agencies which are called upon to play a role in preparation for the UN Conference on Science and Technology. I am sure the experience which has been gained by that specialized agency will be utilized by the Conference when it convenes in Vienna in August.

PAPER 4.2 - HIGH TECHNOLOGY QUALITY CONTROL IN A NEWLY INDUSTRIALIZING SOCIETY

Dr. Lee Kum Tatt, Chairman
Singapore Institute of Standards and Industrial Research (SISIR); and
Singapore Standards Council
Singapore

INTRODUCTION

From what has been said so far in this Seminar, one could gain the impression that quality control has been with us for a long, long time. I think that that is the wrong impression. I think we should correct that. Quality control is a relatively new science. I am very happy to hear from my colleague, Dr. Stephens, this morning, that UNIDO is going to advocate an integrated approach of standardization, quality control, extension, and industrial research. Some ten years ago, when we tried to start an institute called SISIR, I received nothing but brickbats against an organization of this nature. It was said that standardization, quality control, and industrial research are incompatible. I am very happy indeed, Dr. Stephens, to hear as you say, that UNIDO has accepted this concept. On my part, and on our part in Singapore, we have had no models to follow. And with the brickbats, it has not been an easy task.

So today, I think that most of the points of how to set up a quality control system and to relate to this standardization and extension, and for that matter, industrial research, have been quite well presented by the various speakers, especially by Dr. Stephens this morning. I will only go through with you some of the salient points of our experiences that we have had in Singapore.

Now the facts are these: I think the ingredients are there, just like our food. We eat fish, we eat wheat, we eat vegetables. It is how we put them together that makes the difference. If we put them wrongly together, they taste awful!

So, in Singapore, just in case some of you may not know what Singapore is, we are only an island of 227 square miles, twice the size of Martha's Vineyard, with 2.3 million people, while Martha's Vineyard has 5,000, and 50,000 in the summer time. It is very significant, because we have a change of more than 1% in land area, between the tides. We have no natural resources, and not even enough water of our own.

This morning, I would like, therefore, to talk to you on quality control, not in the world context, but in the Singapore context, and then, on what we see of the future. I would like to say here, that it is easier to have hindsight than foresight. It is very safe to tell you what we have done because we bury our mistakes. It is very difficult and dangerous to forecast the future, especially when we are asked to do it for the next five years. I will still be around, you know!

2. QUALITY CONTROL IN THE WORLD CONTEXT

The future can be discerned by looking into the past. If we go back just some 50 years, we will find that at one time quality control was confined to inspection. This was the situation through the 19th Century and into the 1920s. No theory, organized practice, nor real knowledge of quality control was present. Then came the pioneers--people like Shewhart and Edwards-- who introduced statistical sampling as a unique and useful tool. This was in the mid-20s and what happened was that variability and its statistical measurements, already used widely in the scientific world, were applied into the world of manufactured products. The work of Shewhart and his colleagues laid the foundation for quality control as a separate and essential discipline for industrial production. Because of the depression, however, very few industrial enterprises listened to the quality control people.

The depression dragged on through the decade of the 30s. Then came World War II, and vast quantities of materials were needed. By the end of the 1940s, quality control was firmly established in military procurement, but was still largely confined to the quality control of production. By the 1950s, quality control had moved from production to design and development, while continuing to

exert a major influence in procurement and production. Today, quality control and its applications have further shifted as a result of consumer pressures which have transformed quality from a product attribute into a social cause. It has made quality control a necessary step in every phase of manufacturing and trading from the conception, to design, development, production, marketing, and servicing. From present trends, quality control professionals will likely be drawn into the public arena in the role of mediators of quality and safety between consumers, producers, and government regulatory agencies. Particularly in the developed countries, the quality control professional has to cope with the contending voices of advocates for consumers, industry, and government regarding the quality, safety, and durability of mass production articles.

What, then, can a small developing city state like Singapore, with a population of 2.4 million and a manufacturing sector comprising 2,847 establishments with output valued at $18,456 million do?* Singapore is further handicapped by the lack of raw materials resources. Unlike the generality of developing countries, Singapore does not have an agricultural base. As a compact urban society, the pressures on Singapore for rapid industrial development were even greater. The gist of the Singapore solution, as Prime Minister Lee Kuan Yew and his colleagues saw and formulated, was plain and straightforward -- Singapore must industrialize or bust. What part did quality control play in this process of industrialization? Perhaps we can extrapolate from what Singapore did in the past in the area of quality control and attempt to forecast what Singapore should do in the future.

3. QUALITY CONTROL IN SINGAPORE

Industrialization was actively pursued in Singapore in the early 60s, when the Government embarked on an active program to attract investments into Singapore as the major thrust of its national economic plan. Prior to that, Singapore's only experience was in trading, where the ideal location of the country made it a centre for entrepot trade. The plan to transform a trading economy into an industrialized society was not easy. The mentality of traders is entirely different from that of industrialists. The time frames of risk-taking are very different. With a limited population base and no natural resources, how could Singapore hope to attract investments in manufacturing? Singapore could then boast of a fairly developed infrastructure in shipping, transportation, education, and finance. These were plus factors, and together with the Government's arm, the Economic Development Board (EDB), set up in 1960 to promote investments, Singapore opened its doors to manufacturing. The Singapore government is a socialist government. It has been an embarrassment at one time, stated by the Deputy Prime Minister himself, that it protects the capitalists more than the capitalist countries.

When Singapore became part of Malaysia in August 1963, the stage was set for greater growth in manufacturing in view of the larger market associated with the much larger population base. We attracted industries who came on the basis of this large internal market. This union with Malaysia, was, however, short-lived; and in 1965 Singapore was separated from Malaysia. Independence followed in August 1965, and Singapore had to learn to stand on its own two feet. All the effort that we had put in to promote industries based on the bigger internal market, the premise on which these industries were built, was no longer valid. Survival became a mission for the Government. We had to change all of our industry; we had to become export oriented.

Amidst all this, the EDB as part of its program to attract manufacturing investments, established a number of technological institutions to service industries which were to set up based in Singapore. One of these institutions was the Industrial Research Unit (IRU), set up in 1963 to do research on raw materials usage and to provide testing services to industries. Standardization was instituted as a program of IRU in 1966. In 1969, in view of the greater emphasis placed on standardization and quality control, the IRU was converted and renamed the Singapore

*The figures given are in Singapore $. One U.S. $ ≐ S$2.20.

Institute of Standards and Industrial Research (SISIR). If I were to be asked what year Singapore embarked on an active program to promote quality control in the manufacturing sector, I would choose 1969 as the base year.

In 1969, the manufacturing sector comprised 1,714 establishments, employing some 100,758 workers with an output valued at $3,214 million. In contrast, by 1977, the manufacturing sector had 2,847 establishments, employing 200,112 workers with an output valued at $18,456 million. In 1969, direct exports from Singapore were valued at $1,265 million and comprised mainly low value items, especially in the traditional industries such as food, garments, plywood, and plastics. By 1977, exports were valued at $10,160 million and products have shifted to high value added items and sophisticated engineering and electronic components and parts. These data are all reflected in Annex I. Annex II shows the principal statistics of manufacturing by major industry group as of 1977. This transformation has not been easy. It has been very painful. It has cost us a lot.

What part did quality control play in all these developments? How was quality control promoted, especially among local entrepreneurs who have had no tradition in manufacturing? What specific programs were instituted by the Government through SISIR to promote quality control as part and parcel of production processes? Did the developments in quality control in the developed economies have any impact or effect on Singapore? What will be the role of quality control professionals in Singapore for the future? Will consumerism in the developed economies affect Singapore? How will and how can the developed countries play a role in their commitment towards assisting the less developed countries to develop their economies?

I hope that the Singapore experience will provide the distinguished delegates at this Seminar an insight into what the developed countries can do for the newly industrializing countries. I hope also that by relating to you our experiences in introducing and developing quality control as a discipline among our manufacturers, some of you will be able to decide how best developing economies could be assisted through quality control to develop better quality living.

The Singapore Government's policy to accelerate industrialization was based on the premise that it will be faster and less costly to benefit from the experiences of others. An aggressive policy of attracting investments, particularly from the multi-national corporations of the USA, Europe, and Japan, was pursued. This would provide the base for infrastructures to be developed, while at the same time, allow time for local entrepreneurs to have a feel of what manufacturing is and the types of management and organization required to manage manufacturing operations. The multi-nationals brought with them not only manufacturing and management experiences but also ready markets for their own products. On the other hand, Singapore manufacturing operations, when established, will not have immediate access to international markets. Singapore manufactured products do not enjoy the luxury of a large local consumer population. There is only one answer and that is, Singapore manufacturers must export the bulk of their products. Quality control therefore must become a vital process in the manufacturing operations of Singaporeans. How does one promote the concept of quality control in a newly industrializing economy? How does one persuade manufacturers to invest in plant, machinery, and equipment to control the quality of products?

To my mind, Singapore promoted quality control among its industries through a combination of the following mechanisms:

1. The presence of multi-national corporations.

2. The introduction of a national certification scheme.

3. The formulation of a professional organization of quality control practitioners and production engineers.

4. Government support for products certified under the national certification program.

5. The policy of pursuing governmental entrepreneurship where government invests in a number of manufacturing operations.

6. The restructuring of the educational system towards the scientific and technical, and later, the provision of industrial training.

7. The provision of specialised quality control awareness programs and courses for industry.

8. Nation-wide campaigns to promote quality as a way of life.

These were all pursued with intensive vigour from the period 1969 onwards up to today.

3.1 Presence of Multi-national Corporations

The presence of multi-nationals serves to demonstrate to local manufacturers how effective manufacturing operations can be managed and controlled. We made a statistical study. Multi-nationals do fail, also, but only up to 6%. Locals, they fail, 30%, joint ventures, 7%. What does this mean? It means that we don't have enough entrepreneurship, we don't have the experience to manage. That, we have to pay a price for. Multi-nationals also provided employment for Singaporean workers, and many of these workers would for the first time be introduced to the concepts of quality control in production.

3.2 National Certification Scheme

SISIR introduced a national certification scheme for locally manufactured products in 1971. This very active scheme covers multi-nationals as well as indigenous manufacturers. Today, over 450 brands and products are covered under the national certification program, both those with standards and those for which there are no national standards, with products ranging from edible oils to sophisticated electronic products and components such as calculators, electric motors, twist drills, cameras, projectors, flash guns, circuit breakers, etc. An annual Buyers' Guide is produced listing the companies and products under the certification program. We also do export inspection.

3.3 Formulation of a Professional Organization

To promote quality control awareness among workers and professionals in Singapore, SISIR initiated the formation of a Singapore Quality and Reliability Association (SQRA) whose membership is drawn from QC practitioners in industry as well as from companies which subscribe to the QC movement. This is a very prestigious organization. Our first chairman is now Ambassador to Moscow. Our second chairman is now Senior Minister of State for Finance. Our third chairman is the Cabinet Minister in charge of industrial training. So the Singapore Quality and Reliability Association is well-patronized. Today, the SQRA has 400 individual members and 80 company members. Dr. Stephens is a member. Some 40% of the individual membership are QC practitioners working in multi-national corporations. The SQRA thus serves as an instrument whereby QC practitioners from indigenous firms will be able to mix and interact freely with QC practitioners from the multi-nationals. The SQRA also actively conducts courses for its members, holds seminars, and plans factory visits to companies of interest.

3.4 Government Support

Initially, to attract manufacturers to come into the national certification scheme (it is, by the way, voluntary in nature), government departments, statutory organizations and government-owned enterprises gave preference to products certified by SISIR in their purchases. This indirect incentive was necessary during the early days of the certification program to attract Singapore manufacturers to participate. Today, although the government still gives preference to products certified by SISIR, such incentives are no longer regarded as essential by local manufacturers. The message that quality control need not necessarily result in increased production

cost and in fact could be a cost saving instrument has sunk in.

3.5 Governmental Entrepreneurship

Dynamic governmental entrepreneurship, which evoked positive responses from the private sector, yielded high economic growth rates. Government-owned enterprises were set up initially in ventures considered as strategic to the national industrialization program or in ventures where through government sharing of the risks, private sector participation could be forthcoming. Government-owned enterprises had to be managed in a more professional manner, and the fact that such operations could introduce quality control and yet achieve high profit margins served to demonstrate that quality control programs can be managed by locals.

We do not consider government investment as interference. We consider it as part of sharing the risk with entrepreneurs. We do not go in if we are not wanted. Also, when we do industrial research, we come up with a product, we approach industries. The first question they ask is, if it is so good, why don't you do it yourself? Very often, we did not have the mechanism. Now we have. OK, we will do it ourselves. And nothing succeeds like success. We have demonstrated in a small way that we can make money out of our own research projects. This is a mechanism which we have developed within SISIR.

3.6 Restructuring of the Educational System

On this we place a very strong empasis. We only have human resources. Babies, we can't export, and so we have to educate them for productive employment. We spend one third of all of our national budget on training, not only at the University level, but also in Singapore Polytechnic and industrial training. For multi-nationals who come here, we subsidize part of their training.

When the quality control movement took root in Singapore, there was need not only for engineers and QC professionals, there was also need for the manufacturing sector to have skilled workers and technicians at all levels. The government restructured the educational system towards the scientific and technical in 1969. The engineering faculties of the University and the Polytechnic and technical colleges were rapidly expanded. From 1969, most students entering secondary schools began a 2-year course combining academic and technical subjects. Whereas the student enrollment ratio between academic and technical education was 6:1 in 1968, a ratio of 3:1 was reached by 1972. In 1959, when I was first time appointed as Governor of Singapore Polytechnic, we only produced 150 graduates per year. Today, we produce 1,800 in the Polytechnic alone; our student enrollment is 8,000. And we have set up another polytechnic in the same time. It cost us a lot of money, but this has worked well. To ensure that industrial training meets the needs of industry, industry-based training centres subsidized by the government, were set up. Industry-based training also includes overseas training schemes, apprenticeship schemes, and on-the-job training programs.

3.7 Provision of Specialized Quality Control Awareness Programs and Courses

Various organizations in Singapore, such as SISIR and the National Productivity Board, conduct quality control courses for management, QC practitioners, QC technicians, and operatives. In particular, SISIR conducts regularly specialized courses every year, catering to different types of industries or different levels of workers. From general awareness courses, the courses conducted today in SISIR are more specialized, and specific industrial groups or industries are being catered for.

3.8 Nation-wide Campaigns to Promote Quality as a Way of Life

We believe that everything should be done voluntarily. We should get the people on our side. Campaigns are a fact of life in modern Singapore. We had the 'Keep Singapore Clean and Green" campaign; "Use Your Hands" campaign; "Courtesy is our Way of Life" campaign; and "Stop at Two" campaign. In 1973, SISIR, in collaboration with the National Trades Union Congress (Singapore Workers' Union) and the Singapore Manufacturers' Association (association of

some 800 Singapore manufacturers), organized a nation-wide campaign to promote "Prosperity Through Quality and Reliability (PQR)". The campaign, which lasted for one year, involved all of the politicians, everybody who believed in quality (they cannot afford not to believe), some 70,000 workers, 146 schools, 300 companies, government ministries and organizations like the Consumers' Association of Singapore, and the Singapore Quality and Reliability Association. The objective of the campaign was to make Singapore industrialists, workers, and the man in the street to be more aware of the necessity and importance of making Singapore goods synonymous with quality and reliability. So they flew our flags, our flags were all over Singapore.

The "Stop at Two" family plannning campaign has been very effective. I said that we paid a price for what we have. Our population growth was 3.6% not so long ago. We believe that if we want something, we pay a price for it; this is one of our philosophies. So, if we have more than two children, the third child involves no maternity leave for the mother, no free accouchement in the hospitals. So people have to choose whether they want a TV set or an extra child -- no unloading unnecessary responsibilities onto the poor society of which we form a part. That is one of the prices we pay.

4. THE DECADE OF THE 1980s - THE ROLE OF QUALITY CONTROL

We have satisfied the quantitative needs, e.g., to provide enough schools. What we have to do for the next decade is to improve on the quality of life.

We have no more unemployment, and there we have problems, too. Wages are going up, which is one of the objectives of industrialization. Certain industries operating in Singapore now are no longer competitive. What are they to do? We help them to get to other places where they are more competitive. And in this way we are also helping the countries in the region in industrialization. Ambassador Wilkowski was very careful last night not to define what is "appropriate technology". We feel that the industries of the private sector know best, they know how to adapt themselves, and in this way we have spread industrialization and transferred technology from Singapore. Because, we are limited by physical size -- 224 square miles at high tide, don't you forget -- the country can only hold so many people, more than that, we will sink. So we have to keep the number constant, and the only way is to keep on increasing our quality.

We will need more sophisticated metrological services in the years to come. In the past (1969), we started it wrongly. We spent around $2 million -- there was no use for it -- all the equipment went to waste. That reminds me of a saying, "Even the dust has its use if it is found in the right place at the right time." So now, we will start again, and I think this time is the right time.

Just as the manufacturing sector in Singapore was supposed to bear the brunt of employment creation in the 1960s, and economic modernization in the 1970s, manufacturing is expected to take the lead in technological development and economic diversification in the 1980s. The government has provided incentives to manufacturers, potential and existing, to move to more sophisticated operations with a higher technological content. Besides manufacturing, other economic sectors, including the banking and financial sector and the transport and communications sector, are expected to contribute towards this economic diversification in the 1980s. It is also envisaged that Singapore will serve as a regional centre for consultancy services in areas as diverse as banking, management, engineering, urban development, medicine, and technological development.

The economic strategy for the 1980s, based upon a Singapore diversifying in many fronts, can succeed only if Singaporeans are prepared to absorb swiftly innovations developed overseas and also, at the same time, to carry out technological development indigenously.

The quality control movement in Singapore has developed rather rapidly in response to the needs of the export markets and through

planned and calculated promotion at the national level. As Singapore manufactures for the world markets, it is inevitable that the pressures of consumerism in the developed countries will also affect Singapore manufacturers. Quality control will, therefore, involve not just product quality but also issues such as consumer product safety, product reliability, mandatory standards, product traceability, warranties, and even perhaps compulsory export inspection. This then will be the change in the manufacturing sector which the government and SISIR will have to bring about in the 1980s.

I have described to you how Singapore introduced quality control to the manufacturing sector; how quality control was promoted actively; and how certain infrastructures were developed simultaneously. Many would ascribe Singapore's success in this area to the three measures mentioned earlier on. I personally feel that there is another dimension which may be equally important or much more important. This dimension I shall refer to as the question of attitude and philosophy.

Many aid agencies in their programs to assist the developing countries to institute quality control programs for industries have invariably proposed huge structures in the form of national physical standards laboratories or testing laboratories. Many of these structures are today what I would call physical beings without a soul. We had some of them in Singapore. One reason for this could be due to the fact that these structures were set up not to meet a need, but with the hope that that need can be created. In Singapore, we have chosen to establish institutions to meet expressed needs.

Coming back to the question of attitude and philosophy, I would say that our ability to introduce quality control, maintain and sustain it to the present stage, is due not only to the infrastructure built, programs or mechanisms introduced, but due to the fact that the people involved were constantly being inculcated with the right attitude, the pride of work, the pride of belonging to a company. We started off with a philosophy of thinking, and that philosophy had to be sown into the minds of the people as values. When these values take roots and become institutionalized, we end up with a tradition. When that tradition is entrenched, it becomes part of the culture. It is hoped that quality control will become a tradition among Singapore manufacturers. Our ultimate aim is to make it a part of our culture.

Whether or not we will succeed is a difficult question to answer. However, if the past is an indication of what a newly industrializing society with limited resources and with an open policy of free competition and trading can do, then gentlemen, I have every cause to be optimistic. I would like to share with you these words of Prime Minister Lee which I think will provide you with the type of scenario under which industries have been and will be operating in Singapore:

"It is the consciousness of our being co-owners of the new society we are creating that provides the drive for fulfillment. Developing the economy, increasing productivity, increasing returns, these make sense only when fair play and fair shares make it worth everyone's while to put in his share of effort for group survival and group prosperity."

We believe to get from each his best, to each his worth. In introducing this system we may need a few missionaries.

I believe that there is much that the developed countries like the U.S. can do for the developing countries. If the U.S. can decide to send men to the moon, I believe it can also make the technologies available to make deserts productive. What is needed may be the political will.

ANNEX I. PRINCIPAL STATISTICS OF MANUFACTURING, 1969 AND 1973-1977

	Unit	1969	1973	1974	1975	1976	1977
Establishments	Number	1,714	2,100	2,201	2,405	2,524	2,847
Employment	Number	100,758	201,813	209,214	194,258	209,875	220,112
Output	$ Million	3,214	8,687	14,215	13,165	16,131	18,456
Value Added	$ Million	957	2,591	3,579	3,439	4,007	4,419
Direct Exports	$ Million	1,265	4,779	8,520	7,610	10,160	12,145

DISCUSSION:

Mr. Jacob Blackburn (Director, Office of Technology Policy and Space Affairs, U.S. Dept. of State):

I am very interested in the society which you are developing. What is your unemployment level at the present time? Do you have any problem of that sort at all?

Dr. Lee:

Statistics conceal as much as they reveal. So if you go by statistics, we are supposed to have about 3%. But I think you have to analyze how these statistics are gathered. People just register with the Ministry of Labor when they want a job. Some of them are not employable. And some of them only want to change jobs. As a matter of fact, we have quite a number of guest workers from Malaysia. So we really do not have a serious unemployment problem.

Dr. Edward L. Brady (NBS):

Dr. Lee, you say that the total GNP is about $18,000 million. Is that correct? With a population of about 2.4 million, that comes out to be something over $7,000 GNP per capita per year, and that is comparable with the United States right now. Is that correct?

Dr. Lee:

Sir, as I say, statistics are dangerous. We are the fourth if not the third largest refinery in the world, and with the oil price going up, the refinery output constitutes something like 40% of our GNP or GDP. Unless you know the details, statistics conceal as much as they reveal.

Mr. William L. Eilers (AID Coordinator for UNCSTD, U.S. Dept. of State):

Singapore is often known as a rugged or tough society. Do you have compulsion upon manufacturers to adopt quality control, or do you depend mostly upon persuasion?

Dr. Lee:

We have compulsion only when it involves safety and health. And that legislation is the responsibility of the Ministries, not the Singapore Institute of Standards and Industrial Research. The rest is essentially on a voluntary basis of what is good for them. We require a lot of persuasion, but it works. The main thing is to get started. The most difficult part is to get started. Let me say this, in 1963, we got started, somebody started. We got two firms in, after six months, no more in, the two firms left. So we waited until 1969, before we started again. And this time, we got it going.

Mr. Albert Baron (Special Adviser, Dept. for Technical Cooperation for Development, United Nations, New York City):

Dr. Lee, with the tremendous success that your country has had, even at high tide, it seems to me that you have a great deal to offer other developing countries. I would just like to ask the question, in your region have you done very much interchange with other countries on how to move toward the development of industrial firms, or small and medium size business, how to organize to provide the institutional arrangements that a country needs in terms of quality control, in

ANNEX II. PRINCIPAL STATISTICS OF MANUFACTURING BY MAJOR INDUSTRY GROUP, 1977p

	Establishment		Employment		Remuneration		Output		Value Added		Workers Per Establishment	Remuneration Per Worker	Value Added Per Worker	Ratio of Value Added to Output
	No	%	No	%	$ Mil	%	$ Mil	%	$ Mil	%	No	$ 000	$ 000	%
Food Beverages and Tobacco	269	9.5	13,109	6.0	89.5	6.3	1,374.0	7.8	265.5	6.1	49	6.8	20.3	19.3
Textiles	80	2.8	10,986	5.1	53.6	3.8	356.3	2.0	118.9	2.7	137	4.9	10.8	33.4
Apparel and Leather Products	377	13.3	23,941	11.0	85.8	6.0	461.9	2.6	152.5	3.5	64	3.6	6.4	33.0
Wood except Furniture	144	5.1	9,639	4.4	53.6	3.8	436.4	2.5	137.5	3.2	67	5.6	14.3	31.5
Furniture	76	2.7	3,182	1.5	16.6	1.2	68.5	0.4	28.1	0.6	42	5.2	8.8	41.0
Paper and Printing	334	11.8	13,466	6.2	84.6	6.0	460.7	2.6	211.6	4.8	40	6.3	15.7	45.9
Chemical Products	118	4.2	5,240	2.4	48.7	3.4	575.1	3.3	230.2	5.3	44	9.3	43.9	40.0
Petroleum	11	0.4	3,521	1.6	80.7	5.7	7,530.0	42.7	783.2	17.9	320	22.9	222.4	10.4
Rubber and Plastic Products	207	7.3	7,813	3.6	38.2	2.7	257.3	1.5	83.9	1.9	38	4.9	10.7	32.6
Nonmetallic Minerals	79	2.8	5,095	2.3	39.7	2.8	369.1	2.1	136.5	3.1	64	7.8	26.8	37.0
Basic Metals	23	0.8	1,545	0.7	15.3	1.1	166.7	0.9	57.5	1.3	67	9.9	37.2	34.5
Fabricated Metal Products	259	9.2	12,517	5.8	84.5	5.9	535.8	3.0	177.0	4.1	48	6.8	14.1	33.0
Machinery and Appliances	492	17.4	66,952	30.8	404.2	28.5	3,325.6	18.9	1,222.4	27.9	136	6.0	18.3	36.8
Transport Equipment	224	7.9	27,886	12.8	259.4	18.3	1,313.2	7.4	595.9	13.6	124	9.3	21.4	45.4
Precision Equipment	40	1.4	7,902	3.6	42.1	3.0	217.0	1.2	122.5	2.8	198	5.3	15.5	56.5
Miscellaneous	97	3.4	4,754	2.2	21.9	1.5	194.9	1.1	53.3	1.2	49	4.6	11.2	27.3
TOTAL excl Rubber Processing	2,830	100.0	217,548	100.0	1,418.4	100.0	17,642.5	100.0	4,376.5	100.0	77	6.5	20.1	24.8
Rubber Processing	17		2,564		15.2		813.0		42.2		151	5.9	16.5	5.2
TOTAL incl Rubber Processing	2,847		220,112		1,433.6		18,455.5		4,418.7		77	6.5	20.1	23.9

Note: Refers to establishments engaging 10 or more persons.

Source: Department of Statistics

terms of research, training, and so on? In other words, has there been an exchange of information with other developing countries from Singapore to give them the benefit of your know-how?

Dr. Lee:

Yes, the answer is yes. We have very many programs. One of them is that we are a member of the Commmonwealth, and we have got Commonwealth Scholarships, I think more than 1,000 a year, training for nursing, customs, port tending, and so on. Also, our Institute, and I myself, are actively involved in technical information exchange. In 1970, we initiated this regional program, with Canadian help (IDRC), it is called Technonet, the technical information network of Asia. This one is not a governmental network. We want it to be I-to-I, Institute to Institute, not G-to-G. G-to-G has too much bureaucracy. So we have I-to-I linkage. We now have 11 members, including Korea, Hong Kong, Indonesia, Malaysia, Philippines, Thailand, Singapore, Bangladesh, and Sri Lanka. We get together, and we do exchange information.

There are two services we provide. One is an awareness service, that is, we collect what we have, and we distribute it to whomever wants it, just like your journals. The user must give us an interest profile. Otherwise they will be over-documented, and under-informed. Then we have the Question and Answer service, which is more difficult. And that is where we need external support. You see, we operate like a bank. I would like to say this very clearly. Even for my own Institute, I have to make sure that the bottom line is black. So, when we operate an information service, we want to have an exchange. If a person comes to the bank and only draws out money, pretty soon the bank will go bankrupt. Initially, we do not mind people coming in and getting information from us, and we get it from Canada and from the U.S. and from UNIDO and everywhere else, but ultimately -- in a year or two years or three years -- they must bring some information and put it into our computer. That is the only condition we have. And that way they all help to submit information. And very often we help a small industry in procuring supplies, if not know-how.

PAPER 4.3 - ON PROVIDING THE TECHNOLOGICAL KNOWLEDGE BASE FOR INDUSTRIALIZING BARBADOS

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1. QUALITY CONTROL IN BARBADOS

Barbados embarked on a program of industrialization about 10-15 years ago. It has been well recognized that improvements in our metrological service must be made if our goals are to be achieved. One area in which it is expected that great benefits will be derived from improved metrological services is that of Quality Control, both in the metrological service and in industry which, it is planned, will be monitored through such instruments as intra-factory quality control programs and a Certification Marking Scheme to be conducted by the Barbados National Standards Institution (BNSI), as well as preshipment inspection of goods for export, possibly under the supervision of BNSI.

In an effort to make such a goal a reality our needs may be placed in three categories, namely:

1. Training of personnel.
2. Establishment of appropriate laboratory facilities.
3. The acquisition of appropriate machinery and equipment for testing.

With regard to the first of these categories, it must be said that during the first three years of the establishment of the Barbados National Standards Institution, an expert in quality control provided by UNIDO advised on the implementation of quality control measures in industry and conducted some preliminary courses on the topic among managerial personnel as well as technical staff in industry. There is, however, further need for training of our governmental and industrial middle management in:

1. The theory and practice of measurement, with the emphasis on the treatment and analysis of errors.
2. The statistical basis for establishing the degree of precision and accuracy in both the manufacturing process and the assessment thereof.
3. Procedures for designing statistical sampling plans.
4. Methods of inspection and sampling.

In the second instance it has been acutely realized that the very laboratory procedures necessary to monitor the performance of the manufacturing process must be subjected to quality control analysis, so that training in quality control as it applies to laboratory testing procedures will be necessary for the technical staff in industrial laboratories and at BNSI. Such techniques as the use of control charts, the mathematical concepts of standard deviation, and coefficient of variation, the assessment of the reliability of a measurement, etc., need to be taught throughout industry.

Members of the staff at BNSI have participated in quality control training courses in India, Sweden and elsewhere, but it is necessary that such opportunities be made available also to industrial personnel. Because of the expense in sending large numbers of people abroad, it would be advantageous both for us and sponsoring institutions to have such training courses organized in Barbados.

A major difficulty which our industry faces is the acquisition of proper and appropriate instrumentation for quality control laboratories. One obvious method of surmounting this difficulty is the purchase from abroad of necessary equipment. However, this is known to be expensive, and currently not many industries are likely to be able to afford much of such equipment which very often is too elaborate for their needs and is difficult to service and maintain mainly because of the lack of adequately trained technicians. Another way of overcoming the obstacle is to be able to design and fabricate the simplest possible equipment appropriate to our needs and from less costly and more readily available components.

Indeed, we at BNSI have already been faced with this alternative as the solution of

difficulties encountered when requested to test batteries for automobiles [illegible] approach, however, would nece[illegible]ning in instrumentation for testing [illegible]es, for some of our mechanico- and electro-technical personnel.

2. ESTABLISHING A METROLOGY SERVICE IN BARBADOS WITHIN THE CONTEXT OF A STANDARDS INSTITUTION

In November 1966, when Barbados became an independent nation, modern industrial arts and skills were still, with but a few exceptions, relatively unknown on the island. There were, of course, the long established foundries, two in fact, which made and serviced equipment for the sugar factories; the dry dock in Bridgetown, which offered docking services to such ships as could enter our then small harbour; artisans practicing such skills as plumbing, welding, carpentry, masonry, still mainly with hand tools; and mechanics who repaired automobiles on the island. But apart from the activities associated with the above mentioned establishments and craftsmen, virtually no manufacturing was carried on.

Up until then virtually all trading was done with our traditional colonial partners, Great Britain and Canada, who sent us food and manufactured goods in return for our sugar. To a lesser extent some trade was also carried on with the United States of America.

The Government of the day wisely sought to lead Barbados along the path of industrialization, and to extend our trading activities throughout the world. Its first task was laying down the infrastructural facilities for such a daring process. A new deep water harbour was built and is currently being extended, and industrial sites were developed at favourable locations on the island. Diplomatic relations were established with more and more foreign nations, and Barbados assumed her well earned membership at the United Nations.

It was during these years of national growth that the Barbados Industrial Development Corporation came into being. The activities of this latter body acted as a stimulus for the nurturing of the idea of the establishment of a National Standards Institution, an idea which had been voiced many years before by farsighted statesmen. Some import substitution was beginning to take place in the areas of garments, building materials, processed foods and pharmaceutical trade, and more and more products were being exported to the countries of the Caribbean Free Trade Association and beyond. More and more the need for a Standards Institution, and with it a modern metrological service, was appreciated. It was during this period that UN experts, Mr. Davis and Mr. Gordon Weston, assisted the Barbados Government in examining the desirability and feasibility of establishing the Barbados National Standards Institution as it later became known. Later, with the able assistance of local personnel, UNIDO personnel of the first United Nations country program for Barbados laid the foundations of the Standards Institution. It was to be a major infrastructural support for the promotion of industrial development and expansion of trade. Among its immediate objectives, were:

1. To assist in the metrication changeover in Barbados, and

2. To upgrade the metrology system in Barbados thus assuring equitable value in trade and commerce, both locally and overseas.

In my presentation, therefore, I shall be making specific references to the experience in Barbados during its present attempt to bring up to date its system of metrology. When in 1972 the Government of Barbados decided to commence establishment of the Barbados National Standards Institution, it was obvious that an integrated approach to the problems of modernization in industrial development and standardization had to be taken, so that the implementation of the Standards Institution encompassed within its scope both the establishment of an up-to-date system of legal metrology and the transition from the Imperial system of measurement to the metric system. There is consequently a department of metrology within the Laboratory Section of the Institution and a technical officer of BNSI has been assigned the special task of piloting the varied aspects the

metrication procedures within the ambit of general standards work at BNSI.

The old Weights and Measures Act of Barbados dates back to 1891. Under the Act, the standard of weights and superficial measures in the Island was the same as in the United Kingdom. However, the standard of liquid measure of capacity in Barbados was that in which a gallon was equivalent to 231 in^3 as in the United States of America, whereas the gallon in the United Kingdom was equivalent to 227.274 in^3.

The system was administered by an Inspector of Weights and Measures who was also the Senior Superintendent of Markets. Under the Act, the Inspector was obliged to keep in the Public Market in the city of Bridgetown, in Speightstown, in Holetown, and at every police station, 19 different standards of weights and measures. He had also to supply every Inland Revenue Officer with one of each of these weights and measures. All weights and measures used in trade had therefore to be verified and suitably stamped by the Inspector of Weights and Measures.

It was inevitable that under the conditions prevailing in Barbados up to the present day, that the day to day administration and execution of the provisions of the Weights and Measures Act, was left to persons with inadequate technical training resulting in deficiencies in maintenance and calibration practices necessary to maintain an acceptable standard of measurement throughout the Island.

It is one of the purposes and functions of the BNSI to establish and maintain a Metrology Service, including electrical measurement capabilities. Towards this end, a bill to revise and consolidate the law relating to weights and measures, and to provide for the introduction in Barbados of the International System of Units (SI) and for related matters, was enacted by the Parliament of Barbados in 1977. The provision of a modern system of legal metrology, including as its fundamental base, the measurement of mass, length, time, temperature, and capacity, is recognized to be an essential component in the industrial development process in Barbados. That such a system must take cognizance of the present day expansion of the SI system throughout the world is accepted as inevitable. Provision is made in the Act that every standard of measure shall be verified by such competent institution as the Minister directs (in this case, the Minister of Agriculture, Food and Consumer Affairs). The Act provides for the national standards of weights and measures to be kept at such place, and under such custody and under such conditions, as the Minister determines. It is virtually certain that the place so determined will be the Barbados National Standards Institution.

Our current capability of measuring temperature, time, and electrical quantities is limited, but it is planned to improve capability in these areas by the acquisition of appropriate equipment. Barbados is currently able to attract a number of electronic industries, including computer components assembly plants, and would benefit from having facilities capable of offering appropriate calibration services. We at the Institution will therefore be able to offer in the near future such metrological services as are needed to support most of the local manufacturing and distributive trades, as well as a significant part of the scientific and technical institutions not directly associated with industry and trade.

One of the important facets of our trade is that carried on with our Caribbean Common Market partners. Our work, both in standardization and metrology, consequently has significant impact upon such activity. It is, therefore, not surprising that the efforts at coordinating activities in standardization and metrology have been made through such regional bodies as the Caricom Secretariat and the Caribbean Common Market Standards Council. A survey is being conducted of all the metrological facilities in the Region, with the ultimate goal of identifying a regional reference system of measurement.

There are, at present, a few important areas to which consideration will have to be given. Of prime importance among these is the ability to guarantee with reasonable accuracy the masses and volumes of bulk products intended for international trade. Again, existing reference masses have not been as well cared for as might be expected, and

little attempt has been made to verify their accuracy periodically.

One of the technical difficulties facing the Institution will be its need to carry out all of its calibration procedures under conditions of ambient temperatures varying from 25°C to 31°C outdoors, but perhaps stabilizing around 28°C to 29°C indoors during the daytime. Economic factors prohibit the installation of equipment designed to control temperature and humidity. The fact that the humidity level in Barbados is usually 80% or higher adds to the difficulty of maintaining equipment in good working condition, and will necessitate frequent cleaning and other measures needed to protect equipment from corrosion.

In view of these circumstances, the BNSI will find it necessary to pursue a vigorous programme of training of personnel at all levels in order to re-establish a sound metrological service in Barbados. The first step in this direction was taken when a member of its technical staff participated in a training programme, under the United Nations auspices, held in Moscow, USSR, during August to November, 1977.

BNSI was set up with aid and expert advice from the United Nations Industrial Development Organization (UNIDO). Similar aid will again be forthcoming from UNIDO as part of a second Country Programme for Barbados. Much emphasis will be placed on firmly establishing the metrology department under the guidance of a United Nations expert in Metrology. This will afford further opportunity for training for our laboratory's technical staff. Such training exercises will, of course, have significance also for many other standardization activities, such as advising industry on the use of measurement and measuring instruments in quality control, maintaining the desired accuracy and precision in the Institution's own day to day testing activities, as will be related to such programmes as the Certification Marking Scheme, import and export inspection, and so on.

As mentioned above, the process of metrication in Barbados has already been set in motion and is expected to gather momentum very rapidly, culminating in about the middle of 1979, when it is planned that the Island will have completed the conversion to the metric system. The two processes of establishing a sound metrological service and converting to the SI system of measurement are being closely coordinated at the Standards Institution, through its Standards Implementation Division, in collaboration with appropriate government law-making and administrative bodies. Personnel at the Institution are also engaged in programmes of education on the SI system of measurement, directed at industry, schools, and the general public.

If I may be permitted to speculate a little about the future, the growing concern throughout the world about energy availability and use is shared by Barbados, and there exist two obvious sources to which we may turn in order to meet some part of our energy need. These are solar and wind energy. Already a local industry in the manufacturing and sale of solar water heaters for domestic use has been established. The Standards Institution has been holding talks with manufacturers of these devices with a view of developing programmes for testing of the devices. It will, therefore, undoubtedly become necessary to equip ourselves with instruments capable of measuring solar radiation and to establish proper standards of reference for the calibration of such instruments. Also, as industrial development continues, there will be a need for greater precision and accuracy in engineering, and the Standards Institution will have to upgrade its means of measuring lengths, masses, time, electrical quantities, and temperature in order to cope with the growing needs and aspirations of our nation.

I shall briefly sum up by saying the above brief assessment of our needs would serve to indicate the areas of basic technical knowledge in mathematics and the physical sciences, with particular emphasis on their application to industrial processes, from which we will need to draw, in order to bridge the gap between our aspirations and current capabilities.

PAPER 4.4 - CERTIFICATION AND QUALITY CONTROL PROBLEMS IN GHANA

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In the developed countries, the markets are critical of the quality of products and services offered while in developing countries such as Ghana, preference for products and services is dictated by the price. This factor affects to a great extent the general development of the economy -- especially of industry. In such a situation where the market is sensitive only to quantity and price, industrial production results in a continuous degradation of quality, and this becomes a serious impediment to improving it. The poor person, therefore, spends his meager resources to buy products from which he does not obtain the maximum benefit and thus spends more money in replacements or adaptations and becomes poorer and poorer.

In an attempt to rectify this situation, Ghana established a standards body whose functions include the promulgation of standards and the ultimate implementation of these standards through certification.

Certification

Certification may be defined as "Assurance by or under the supervision of a competent and independent organization that goods are consistently in conformity with a standard or specification."

Problems with Certification

In Ghana, the certification system is generally based on analysis of the finished products with the aim of assessing whether the products satisfy laid down standard specifications. This system in effect represents a quality assurance arrangement which I believe works satisfactorily in highly industrialized countries, where factories have their own well developed quality control systems including laboratories for testing and research purposes. The situation in Ghana is that quality control methods, where they are in operation, are often inadequate.

The available scientific and technical infra-structure is also usually insufficient to provide the necessary technical aid to the factories. Moreover, like a lot of other developing countries, Ghana operates a market which is oriented towards quantity and price rather than quality criteria. It is our experience that the application of the certification system based on analysis of the finished product is effective only for a small part of the industrial output without any serious impact on the general economy of the country.

A way to get round this problem is said to be the adoption of the certification system practiced in Ecuador, which is based on certification of the industrial output, i.e., a type of auditing of the manufacturer's quality control system. This auditing is undertaken by the Ecuador Institute of Standardization under a contract signed with the manufacturer. Inspection methods as well as information analysis are decided upon.

Among the advantages of such a system may be cited the following:

a) It supplements the factory's technical capabilities in quality control;

b) It provides additional means of analysis and assurance;

c) It provides training for factory personnel.

The practice of "auditing the manufacturer's quality control system" operates in Ghana to a large extent. Manufacturers who apply for the Ghana Standards Board Certification Mark, as a condition open their premises for inspection by Technical Staff of the Board. Quality control systems are checked on during the inspection, and where necessary appropriate recommendations for improvement are made. The award of the Certification Mark is dependent mainly on the acceptability of both the quality control system and the quality of the product.

Quality Control

Quality control plays an important part in the certification exercise. Without an efficient quality control set up in a factory, final product examination does not adequately offer the guarantee expected in certification.

The major problem with regard to quality control in Ghana is the lack of understanding among manufacturers as to what the concept is all about. Especially among the semi-literate manufacturers, quality control is thought of as implying the acquisition of highly sophisticated test equipment to undertake final product examination. Other relatively more informed manufacturers consider time spent on quality control (or even the quality control department) as a waste in production time because it does not yield money directly. They easily forget the savings in production waste and excessive inspection costs which arise from the application of quality control practice and techniques.

The question of lack of technical staff also affects the desires of manufacturers to establish quality control systems in their factories.

There is also a problem posed by the present economic constraints which do not permit manufacturers to import the right quality raw materials. Manufacturers import low quality raw materials in an attempt to stretch the scanty foreign exchange allotted to bring in as much raw material as possible in order to keep the factory running until the next allotment. The quality of some of these raw materials brought in is such that one is never surprised to see the quality of the final products that come out.

Some of the problems outlined will be with Ghana for some time. One will only expect considerable changes when the economy shows definite improvement.

SECTION 5 - SEMINAR DINNER PRESENTATION AND DISCUSSION

PAPER 5.1 - UNITED STATES PREPARATIONS FOR THE UNITED NATIONS CONFERENCE ON SCIENCE AND TECHNOLOGY FOR DEVELOPMENT

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I should like to begin by adding my welcome as well to the distinguished visitors from many countries who have come here to this National Bureau of Standards seminar--visitors from Africa, Southeast Asia, and Latin America. I have had the pleasure of talking with them, both during the reception and at dinner time.

Next I would like to congratulate the National Bureau of Standards of the Department of Commerce, as well as the Agency for International Development, for the excellent job of preparation for this important seminar. NBS has a very special place in U.S. preparations for the UN Conference on Science and Technology for Development, which will take place in Vienna next August. Not only does NBS have a vast and useful store of knowledge directly relevant to the objectives of this conference, but it has gained wide experience in sharing this knowledge with other countries and helping them to serve the objectives of the Conference. Other things NBS has include: a sense of real mission in helping the developing countries, and a perception of opportunities in which to employ its skills and experience. One of these opportunities is the UN Conference.

When I assumed my responsibilities, some 15 months ago, as U.S. Coordinator for this Conference, Ed Brady and Steffen Peiser of NBS were the first persons to call on me and to offer their assistance. Jordan Baruch, Assistant Secretary of the Department of Commerce, was one of the first persons I consulted with. And so NBS has been in on U.S. preparations for this Conference right from the start.

Let us now turn to the NBS seminar. How does it fit into United States preparations for UNCSTD? The focus of the seminar is on the technological knowledge base. You have come together to consider such subjects as measurement capabilities; developing country needs and U.S. experience in meeting them; national and international standards, which are a *sine qua non* of effective world trade; the importance of management; quality control; information on technology. From these subjects we are hoping will come helpful guidance and recommendations to us on how we can better prepare for this Conference in a way which will be directly relevant to the needs of developing countries. We are counting on our visitors from other countries to help us in this regard.

I know my good friend, Dr. Herb Fusfeld, has given you some serious challenges in his keynote address. I should like to table another challenge. That is, that you be painstaking in your deliberations so your recommendations will be as relevant as possible to the UNCSTD Conference agenda. Let us take a look at that agenda, which is serving not only as points of discussion in Conference deliberations, but as an outline for the national papers which each country is required to prepare.

There are only three major elements in the Conference agenda, as follows:

First -- the choice and transfer of technology, and the obstacles in the way of this choice or transfer. For example, the developing countries are asking at this Conference how they can pull away from their dependency on foreign technology. How can they expand their education and training? How can they develop more scientists, that is their own scientists, their own engineers? How can they become more self-reliant? Still other questions they are asking are: what has been the historic pattern or trend in their past choices of technology? Did these choices make them more or less dependent?

How can they break such dependency trends? Thus, you can appreciate from what I have said that the essential issue on the agenda is capacity. How can the developing countries improve their indigenous capacity to better choose, select, adapt, and manage, as well as create, their own technology? The purpose of this Conference is to help the developing countries find answers.

The second agenda item addressed is the institutional arrangements for the transfer of technology:

-- How to improve on modes of cooperations between the industrialized countries and developing countries so as to make this relationship more efficient as well as more productive. Your attendance here at the NBS/AID seminar can make a real contribution in the search which we must jointly make for the answers.

-- How to shape new forms of international cooperation in the application of science and technology to development. For its own part, the United States government is thinking of establishing a Foundation for International Technological Cooperation, which President Carter proposed in Caracas, Venezuela. We will talk later about this subject.

As you review the subject matter of this seminar and consider measurement capabilities, quality control work, standards, management, and information systems, I hope you will keep these agenda items in mind. For example, what does your review suggest in terms of new institutional arrangements? Are the transfer means adequate, or are they inadequate? Can private industry as well as the government individually or jointly devise new institutional arrangements as part of our preparations for this Conference? Another question: Can U.S. private industry do more than it now is in helping to meet the capacity issue? If so, what kinds of approaches must we as a government make to industry? We must search for reasons why some institutional arrangements have succeeded, while others have failed, and what are the essential elements in this test which can guide us in looking at new institutional arrangements on a broader geographic scale?

Finally, we come to the third item on the Conference agenda, which deals with the question of how the existing United Nations system can be more effectively used in accelerating inputs of science and technology for development. For example, do we have adequate machinery at the United Nations now without creating new institutions with respect to information systems, regional management training centers, standards institutions? If we have detected weaknesses within the UN system, what should participating countries propose to correct these weaknesses?

Having challenged you to be specific in helping us, I would like to use the remainder of the time this evening to tell you how the United States looks at this UN Conference and how the United States is preparing for it.

The United States believes that science and technology cannot be looked at in isolation simply because science and technology do not operate in a vacuum. They operate within a given economic setting or environment. Let us look for a moment at four separate but interrelated economic problems in the world economy today. There are the industrialized countries, which face the critical question of how to restore growth and progress, how to moderate inflation, how to overcome unemployment. There are the oil exporting countries, who are looking at the question of how to accommodate to the financial surpluses which they now enjoy and which for the most part are deposited in industrialized countries on a short-term basis. These funds must be put into long-term productive investments. Then there are the middle-income developing countries, who face the question of how to resume the remarkable growth rates these countries enjoyed in the late 60s and the early 70s. And then there are the poorest countries in the third and fourth world, who are completely absorbed with the question of how to relieve the dismal prospects of poverty.

Economic observers have traditionally held the view that the rate of growth in the industrialized countries is important to the developing countries; that is, the industrialized countries are viewed as the engine of economic power and the developing countries as the train being pulled along. A neglected view which now appears to be gaining fashion is that growth in the industrialized countries may be strongly affected by growth in the developing countries or the lack of growth, which is worse. If this is true, it behooves us to

help stimulate the developing countries so as to help them and ourselves in our respective national interests.

The United States believes there are benefits for the rich countries in accommodating the proposals of the developing countries for changes in the existing international system. Thus, the United Nations Conference on Science and Technology for Development is a timely event, which comes at a moment of serious structural change in the world economy. So, regardless of the present state of our economies, we are all asking if the industrialized countries and the developing countries can find it in their mutual interests to create a new set of economic relations to enable both sides to achieve their respective economic and social goals.

Increasingly, we are finding the importance of drawing attention to United States trade with the developing countries. In 1977, 35% of total United States exports, or $42 billion, went to the developing countries. Forty percent of all U.S. manufactures are presently going to developing countries, or more than the total which the United States ships to Western Europe, Japan, Eastern Europe, and the Soviet Union combined. On the import side, it is noteworthy that 40% of our total imports, or $67 billion, comes from developing countries. Comparing the totals of exports versus imports, it is obvious that the United States has a deficit balance with the developing countries of about $25 billion.

It is obvious that to the extent we can improve developing countries' capacity to choose U.S. technology, these countries should thus be in a better technical position to buy more from the United States, and for the United States to sell more and ultimately to narrow this trade deficit. So we return to the original proposition that it should be in the U.S. interest, as well as developing country interests, to serve the basic objectives of this Conference. Thus, in examining how the United States is looking at UNCSTD, we conclude that we have legitimate interests at stake. UNCSTD comes at a time when there are fundamental changes occurring in the world economic sector, changes which will profoundly affect the shape of the world in the next 20 years, into the year 2000.

Our next topic concerns what the United States is doing to prepare for this Conference. First of all, I should clarify that the Conference is actually in session and has been in session since the first preparatory committee met in New York in January of 1977. We believe that the preparations for this Conference are as important, if not more important, than the two-week formal session in Vienna next August. The Conference has called for elaborate preparations at the national, regional, and international levels. There have been two preparatory meetings -- in New York in January of 1977, in Geneva in January of this year -- and there will be a third prepcom in New York in January of next year, with perhaps a fourth prepcom in May at a site to be determined before the final Conference in Vienna in August. This Conference is a highly complex international meeting on global issues. It is both highly technical and political. It is part of the North-South dialogue, and the issues are ones of justice and equity as well as economic growth and progress.

United Nations conferences have tended to raise the consciousness or awareness of participating governments on global issues. They often cause governments to do what they might otherwise avoid. As the developing countries prepare, they have tended to review and evaluate their economic development policies and the role which science and technology has in their plans and policies. This is causing developing countries to develop more coherent and comprehensive science and technology policies, to link their public and private sectors more intimately. Some developing countries have begun serious questioning of elitism in science and technology and to urge more practical links with the productive sectors. Finally, preparations in the developing countries have enabled them to prepare clearer statements of their needs and requirements which are being set forth in their national papers.

On the industrialized country side, the United States has also made a policy review, and it has questioned whether it has an

appropriate or coherent U.S. policy on science and technology for development. In fact, the White House in February of this year has requested that such a policy be drafted for Presidential review. This study is nearing completion. We have also reviewed th role of science and technology in our bilateral assistance programs, and the mandate for international cooperation in science and technology in agencies other than AID. Our national paper has been a difficult one to construct, because as happens with all international conferences, all countries are looking at a new subject almost for the first time. The U.S. national paper will cover the following topics: goals and concepts; the role of science and technology in the development of the United States (that is, a bit of historical review); the private sector experience; the U.S. government experience in applying science and technology to development overseas; international institutional arrangements; and, finally, issues and approaches.

Let me read to you the introductory statement of the national paper:

"In 1976, seventeen distinguished scientists and engineers from eight countries around the world met in Bellagio, Italy, under the auspices of the U.S. National Academy of Sciences to discuss the role that science and technology can play in helping solve some of the world's major problems. This group offered the following general observation:

"'Humanity is, for the first time in its history, within reach of managing its fate toward a better life for all. This new condition has been reached through a period of two centuries of intensive application of science and technology to the satisfaction of human wants. But the benefits of technology have not been shared equally by all nations. A thirst for these benefits is the focus of rising expectations for a better life in many parts of the world still in the grip of poverty and uncertainty about the future.*'"

*Science, Technology and Society -- a Prospective Look, U.S. National Academy of Sciences, 1976.

The foregoing statement is the work of the former head of the National Bureau of Standards, Dr. Lewis Branscomb, now Chief Scientist for IBM. He is also a member of the United States Steering Committee concerned with U.S. preparations for the Conference.

So much for United States approach to the UN Conference. Our preparations have focussed on a policy review and writing of the national paper.

Let us turn to other preparatory efforts. We undertook a number of background studies, the more prominent of which were those done by the National Academy of Science and the Fund for Multinational Management Education. In addition, we have undertaken at least two dozen special research projects related to various topics of the Conference agenda. And we are sponsoring any number of workshops or items related to the three-point Conference agenda. For example, we have coming up in November a series of four workshops in collaboration with the International Management and Development Institute, which will be testing some of the propositions developed on industrialization in the two studies mentioned -- the NAS and FMME studies. Another workshop with Winrock in Arkansas will focus on appropriate technology. All in all, we see ourselves as completing phase one of U.S. preparations, which had to do largely with developing an information base for decisions on U.S. positions. We are beginning phase two, which will deal mainly with what it is the United States might do in the way of new things in its bilateral and multilateral assistance programs focussing on science and technology. We will be looking for common ground which will enable us to join in a consensus with other countries in new programs or initiatives at the Conference. The U.S. proposal for a Foundation for International Technological Cooperation is one of the new ideas the U.S. will be advancing.

As you know, the President of the United States made a proposal in Venezuela that there be such a Foundation. The genesis is some studies which were done at the Brookings Institution and later developed by the Office of Science and Technology, the Office of the Science Adviser to the President.

A Planning Office has been established under the leadership of Dr. Ralph Smuckler of Michigan State and Mr. Princeton Lyman of AID. The FITC would be concerned with many aspects of development. Its essential aims would be as follows:

-- to assist the developing countries in strengthening their indigenous science and technology capabilities;

-- to develop science and technology education and manpower training programs;

-- to encourage both the public and the private sectors engaged in science and technology efforts relevant to development;

-- to support collaborative research and development between the United States and developing country institutions.

The concentration over the next ten months will be on the terms of such a new institution, its programs, and how specifically relevant we can make the FITC, not only to the objectives of the Conference but over the long term leading into the year 2000.

This now brings me full circle to the importance of the NBS/AID seminar. We are looking to you for ideas, suggestions, and recommendations. The United States Government has no monopoly on technology. On the contrary, the bulk of technology resides in the private sector. Whatever our proposals at this Conference, they will have to represent a blend between what it is the U.S. Government can do on non-proprietary technology for which the government has expertise and authority, and proprietary technology, over which private enterprises and not the U.S. government has authority. These distinctions should be made, as both sides in the Conference learn more about each other's capabilities and needs as regards science and technology for development. I wish you well in your deliberations, and I look forward to receiving a set of very useful recommendations.

Thank you.

DISCUSSION:

Dr. Fusfeld:

Since you have a draft of the National Paper in your hand, what is it that you expect during the next four or five months other than editorial corrections? Is the input phase over, or is there still some opportunity or mechanism for meaningful changes?

Ambassador Wilkowski:

The period for inputs into the National Paper is over. But that doesn't mean that private sector inputs for the U.S. position at the Conference are over. The Paper is simply a requirement on the part of the Conference sponsors to get countries to think about their own policies, where they have them or don't have them, to evaluate these policies and to make proposals. It is a starting point for the Conference. But we will continue to welcome inputs from workshops such as yours which affect the position papers we write and the positions that we will take, and the proposals that we will make. For example, we have not attempted to summarize in the National Paper all of the recommendations in all of the research projects, like that of the Academy of Sciences or the Fund for Multinational Management Education (FMME), that we have received so far because we are limited on space. But we will welcome right up until August 1979, ideas from both the public and the private sector for positions that the U.S. Government should take at this Conference.

Dr. Fusfeld:

And are there mechanisms that you envisage by which you will request this in some formal way? How will people who are not intimately involved in the process even know or be exposed to the state of the Paper or the state of what you need, at that point?

Ambassador Wilkowski:

Since we have organized this coordinating office, we have engaged in outreach to the private sector. I have met with many groups, such as this, and so have members of my staff.

The Fund for Multinational Management Education had at least 40 workshops. We have about 10-15 more workshops coming up at which we will make our wants, our needs known. And in addition to that we are in correspondence with a lot of non-governmental organizations and with other private sector agencies. We have a Steering Committee, which has on it representatives of government at the Assistant Secretary level, of industry and business, of research foundations, and of the university and academic community, so that our needs are generally well known, and I think there shouldn't be a problem with this.

Questioner:

Will the National Paper be published in advance of the Conference, do you have a target date?

Ambassador Wilkowski:

Yes, it will be. It will be available from our office. That's another way we will be able to get input. People will see it and will think that this is all wrong, or they should have talked more about this, or here's an idea that I can relate to this point in the paper. They can easily submit these thoughts.

Questioner:

What is the makeup of the U.S. delegation to be?

Ambassador Wilkowski:

It's quite a sensitive question. You can imagine when you have a major United Nations Conference coming up, the number of people that would want to be on the delegation. I would guess the delegation size would be anywhere from about 35 to 65, and there will be a lot of private members; but this is small, and characteristically small, because the Carter Administration wants this. I don't know what the standard ratio has been for private sector to public sector on the delegations. I would guess it might be something like 40% private sector, 60% government. But, at any rate, I have a file for the recommendations that have been coming in. I have been turning these over to Ambassador Hesburgh, the President of Notre Dame, who is chairman of the United States delegation, and he will be discussing the matter with interested people over at the White House. I don't know when he will want to announce the delegation. There will certainly be Congressional members as well as private sector members on it.

Dr. Middleton:

One of the problems that we in the International Organization for Standardization in Geneva have had, is that we are not part of the United Nations system. As you know, standardization is a multidisciplinary activity. We have found it very difficult to find any part of the UN with which we can talk about technology policy. Would it be giving anything away to give an assessment as to whether any part of the UN would be given a leading role as a result of the Conference?

Ambassador Wilkowski:

We have a Secretary General of the Conference at the present time, who is the focal point at the United Nations, and I think you ought to let him know the views of your particular office. There is also the Office of Science and Technology, headed by Dr. Klaus Standke. There is the United Nations Development Program. It seems to be that there are a number of contacts for you, but we have here Mr. Frank Lancetti from our Bureau of International Organizations, and since it is a highly specialized question, I would suggest that you discuss it with him.

Dr. Middleton:

You have, I think, put your finger on the problem. There are so many points of contact. I wonder if you have made any assessment in the U.S. paper as to the role of the UN after the Conference?

Ambassador Wilkowski:

Yes, we have. That's "international institutional arrangements." It's camouflaged by that glittering UN generality.

Prof. Lieberman:

I think you used the words, "appropriate technology."

Ambassador Wilkowski:

Yes, I am bound to. The Congress requires it. If I don't, if I make any public speech, or write anthing, that doesn't have "appropriate technology" in it, I am in error.

Prof. Liebeman:

Whose "appropriateness?" Would you care to go further into it?

Ambassador Wilkowski:

Yes, actually we put it in quotation marks, "appropriate technology." You know, this is a contentious issue, and there is a great deal of tension between those advocates who would satisfy basic human needs with traditional technology, or "light capital" technology, or labor-intensive technology, or what some people call "appropriate technology," but which the developing countries resent, because they say, "who says it's appropriate?" We like to think of it as the right technology, the technology which the people in the developing countries have chosen for their particualr economic, social, and cultural setting, and for the job, development job, that they have in mind.

Prof. Lieberman:

And this will be said at the meeting, as our position?

Ambassador Wilkowski:

Well, it's said in the National Paper.

Questioner;

Has the Conference planning process given any attention to reconciliation of the inevitable differences in views emanating from the politicians and from the technicians at the Conference?

Ambassador Wilkowski:

Well, that, of course, is very much a domestic policy matter. In our preparations, as I tried to point out, we started out with very serious outreach to the private sector, by contracting with the National Research Council, and by going as well to the consortium headed by the FMME, which also had the Council of the Americas and the International Chamber of Commerce in it as well as George Washington University, and our research studies likewise have been spread throughout the sectors of our very pluralistic society here in the United States. That is the way the United States is going about it.

We have plans in our preparations to meet this problem. We are hoping that we will be able to send out what we call travelling seminars, mixed groups of government and private sector people, who would go out to other countries to talk about the content of their National Papers and of our Nation Paper, and we would encourage the meetings to be mixed groups on both sides. I would hope that those of you from embassies here -- Mexico, the Philippines, and others -- would raise this question with your own governments, because we would like to see this Conference a very practical conference, with a reasonable program of action, and not a conference in which politicians, as you suggest, talk with one another.

And we don't want to be talking past one another. It is a government-to-government conference, there is no question about that. It is both a highly technical and a highly political conference, and it is a very complex subject. As I was saying to somebody else, it is not only science, which has its own "Mafia," it's technology which has its own, and it's development, so that it is all three of these disciplines, wrapped up in one, and each of them has their own language, almost their own folk-ways. I don't know whether I have answered your question or not, but we are conscious of the problem, we are trying to do our part in an effort to overcome it.

Questioner:

What you are saying is that the United States is prepared to follow up this Conference with potential bilateral dialogues, or whatever way it may develop, if this problem develops at the Conference?

Ambassador Wilkowski:

Not only to continue, we are doing it now. We have had bilateral conversations with a number of governments. The Argentines are in town; we are having a three-day session; science and technology is on the agenda. Some of the people from my office will be talking with them tomorrow.

Questioner:

What is your reaction to the State Department appropriation bill which denies funds for technical assistance to international organizations? How does this affect your operations?

Ambassador Wilkowski:

This is a very serious action that has been taken on the part of the Congress. The gentleman is referring to a condition that strikes $27 million from the State Department appropriation and forbids any of these funds being used for technical assistance to the United Nations. You may recall that when the President signed that appropriations bill for the State Department, he voiced very strong objections to this action, and having done that, you've caught the will of the Administration, which is to attempt to reverse that. This action was not taken because a majority of the people in the Congress feel this way, but it was taken for a number of reasons which I think you and I might discuss privately before we leave here tonight. Frank Lancetti, do you have anything further to add? You are our expert on the subject.

Mr. Frank Lancetti:

It is true that Congress prefers that the funds, which are normally used by the specialized agencies of the UN, come from a voluntary contribution. The reason for this is that voluntary contributions allow us to control the way taxpayers' funds are used, whereas the contribution to the general budget of the specialized agencies goes into an anonymous accounting fund, which is used generally at the discretion of the Secretary-general of the organization, which denies us control. There are other important implications stemming from this Congressional act, and probably remedial action will be taken within the next two or three months.

Questioner:

I am curious to know to what extent individual members of private enterprise in the U.S.A. will share your commitments. In other words, you are proposing something to the United Nations; do you think that in the future, members of the private enterprise in the U.S.A. will share those commitments with you, although you say that 40% of the members of the delegation will be from private enterprise? Can Company X in the future say, this doesn't concern me?

Ambassador Wilkowski:

Lots of American companies will never hear about this Conference I am sure, but we are making a serious effort to engage them. We have members of the private industry, as I told you, on the Steering Committee, and we have engaged them in making recommendations to us. The FMME study I told you about has three sets of recommendations. One set is to the companies themselves. They themselves have said, "We ought to be doing more of this, more of that, in order to be responsive to developing countries. We've heard what they are saying, and this is what we think we ought to do. More education and training. More laboratories with a conscious policy to employ host country nationals." The FMME consortium made another set of recommendations to the United States Government, and a third set of recommendations to the host countries.

But, to answer your question, we have engaged in a very active campaign to encourage the private sector -- in fact, I was down in Atlanta talking with a group of the IBM people just last week -- we've encouraged them to review what they're doing. Do you know that some of these companies don't even know how many people they have in education

and training, how many people they have of the 220,000 in the United States now, how may of those they are paying for on scholarships. Some of them really don't know, they have not really focussed on this. They have one little branch of the company here doing one thing, and the other, and so forth, and they have not really pulled their stories together. We are trying to encourage them to look into their company operations and to aggregate them on a company basis. We can't aggregate all of them for U.S. industry, we'd never get through with it. But we are trying to get them to think about it by asking them to do this. And I have been corresponding with a number of companies. I have gone out and talked with them, as well. And we hope that we can get a response from them. Because when you look at it, it's quite impressive what they are doing. We have an authority here on a series of workshops, one of the members of my staff. We are going to have four workshops with chief executive officers of the leading corporations. The meetings will be held, one in New York, one in Chicago, one in Atlanta, and another one out in Los Angeles, at which we will again go to the private sector and ask them what they think of this set of five, ten, and twelve recommendations, what they think of the National Academy study recommendations on industrialization, and what they think they can do as a company contribution independently, in the spirit and under the umbrella of this Conference. So we will see what their response is.

Mr. John B. Maieane (First Secretary, Lesotho Embassy):

Which countries have been aproached with respect to the ten recommendations in the FMME report, and which have responded?

Ambassador Wilkowski:

These have only been recommendations from a consortium of American private interests to host countries. We have not attempted to convey those in any formal or official way to the host countries. But in our meetings with developing country representatives, we will bring these recommendations to their attention. In fact, the IMDI workshops which are coming up in these four cities across the United States, will specifically look at those recommendations to the host countries, and we have invitations out to a number of representatives of developing countries, and we will ask them for their reactions to these recommendations to host countries. Will you be in Washington for any time? We would like to invite you to come into our office and we can talk more about it. In this scheme of things I do have a clear set of the countries we are interested in contacting, to visit.

Mr. Radway:

I have a compliment to offer. Is that in order? I am one of the private sector speakers on the agenda for this seminar, and although I don't have an extensive knowledge of previous preparations for previous international conferences, I would like to salute the Ambassador and the entire inter-agency task force and coordinating staff. For as far as I know this effort to communicate and create a dialogue at different levels between the United States Government and the United States private sector has been greater with respect to preparations for this Conference than for any other single event that I am aware of, in the history of this country. And I think that although perhaps the gentleman's key question cannot be answered with certainty, the sense of his question has been answered in that the United States Government under Ambassador Wilkowski has made a major attempt to really engage in a sincere dialogue with the United States private sector to create some mutual understanding and education, which hopefully will be an on-going process in this country. I think that the process of international technology exchange will be benefited by this dialogue going on in the United States. So I offer my compliments.

Ambassador Wilkowski:

Thank you very much.

SECTION 6 - WORKSHOPS - MANAGERIAL RESPONSIBILITIES AND TECHNICAL KNOWLEDGE

Chairmen: Dr. Robert W. Middleton, Assistant Secretary General
International Organization for Standardization, Geneva, Switzerland

Miss Winifred Armstrong, President
International Management Development Institute, New York City, NY

CHAIRMAN'S COMMENTS:

Miss Winifred Armstrong:

I want to share with you some of the questions that we panelists in the two managerial workshops have discussed prior to this session, and which both Dr. Somer's and Dr. Qurashi's papers highlight and elaborate.

Dr. Fusfeld suggested yesterday that in the Western countries industrialization has taken place more or less in synchronization with the rate of growth of technology, that industrialization and technology grew at more or less the same pace. The question that we have been dealing with in this and other sessions is: Can we transfer technology such that it increases the rate of growth of developing countries? Dr. Somer's paper suggested that technology would *not* necessarily increase the rate of growth of a developing country, unless it was tied in with the local technological base. What we mean by that is the local level of skills, the local ways of working, the local infrastructure, the availability of local finance. Dr. Qurashi proposes that foreign + local = technology.

And again, in our discussion, we concluded that the transfer of technology will probably not increase the rate of growth, unless it is tied in with local objectives. These objectives can be increasing the number of people engaged in productive activity, whether as employees, or as suppliers, distributors, or servicers for an enterprise; increasing foreign exchange, either by increasing exports or decreasing imports; using local materials and resources, rather than putting local producers out of work; or producing better or cheaper than an imported product. But, in any case, unless the foreign technology is tied in with the local technology base, and serves local objectives, its transfer may not contribute to increasing the rate of growth.

In a sense, the choice of technology is Management by Objective. The choice relates to the objective that you have, but we have all seen plenty of examples where that has not been the case. Technologies have been "sold" by developed countries and "selected" by developing countries as being "the latest"; latest is not necessarily best. Wrong choices of technology have crippled growth: "too big" can skew the costs forever, raise the price of a good or service beyond what it needs to be; "too high" technology can force workers and small producers out of work. Objectives should determine the choice of technology: not vice versa.

In a sense then, the transfer of technology can be a misnomer. I am playing devil's advocate a bit here, but quite deliberately. You don't transfer technology, you develop technology. Part of your choices are local, part of your choices are foreign. And unless you can combine them usefully, you haven't got a useful output, you haven't achieved your objective.

We all know that technology, in essence, cannot be adopted, that it has at least to be adapted, and we've all had experience with knowing that to operate and adapt a technology you ultimately get to the point where you have to innovate. And part of our problem, part of the wringing of hands in international forums, is over the necessity of developing people who cannot only adapt, but innovate (in both less and more industrialized countries).

Mr. Coria urged me to stress that the need is not only training in a sense of the higher levels -- the design engineers, the people who know the science and technology of materials, the people who understand man and machine relationships -- it is also developing an attitude in the workers and in the entrepreneurs, from top to bottom, to identify problems when they see them, to report those

problems, and to make suggestions. I would note that in the United States, in my limited experience, the best plants are often those where the operator of the machine or the operator on the floor takes the responsibility for identifying the problems, reporting the problems, and making suggestions. At that point the engineer and the operator together work out a solution. The engineer frequently doesn't know what the operating problems are. Thus an attitude of mind by all concerned that "I am responsible for making this work" may be precedent, in a sense, to the successful acquisition and use of a technology over the long term.

Some of what we are getting at here, is that we are *not really transferring* technology. We are *building a system*, in which our choices are in part to take from outside and in part to build from inside, to contribute to growth. And that system is only going to work if it is tied in with and contributes to the growth of the local resources, if it supports local objectives, and if it enables us to work with the technical and innovative skills of local personnel.

PAPER 6.1 - A SURVEY OF DEVELOPMENT EFFORTS IN TURKEY

Professor Tarik G. Somer
Middle East Technical University
Ankara, Turkey

Before presenting you an analysis of various applications in Turkey of standardization, quality control, and technology transfer, I would like to give you a brief outline on Turkey, its present state of development, and the nature of problems being confronted in industrialization. I believe that it is a good representation of a developing country, and the conditions that I am going to describe may also apply to other developing countries.

Turkey is located in the Near-East. Total area of the country is approximately 300,000 square miles; 97% of this land is in Asia, the remainder being in Europe. The population is 45 million. The country is surrounded by the Black, Aegean and Mediterranean Seas. The eastern part and the sea shores are mountainous; the central portion, Anatolia, consists of inland plateaus. After the fall of the Ottoman Empire, which lasted six centuries, the Republic of Turkey was founded in 1923.

Turkey has been an agricultural country for centuries; 60% of the labor force resides in the countryside. Literacy is 62% (76% among men and 48% among women). Main agricultural products are cereals, tobacco, cotton, sugar beets, fruits, vegetables, and nuts.

The following figures should give an idea of the rate of industrialization of Turkey. Since 1962 the industrial production has increased, on the average, 9.7% annually. Gross National Product (GNP) has increased by 18% annually, based on current prices. This corresponds to a 6.7% growth rate when adjusted for inflation. In 1962 agricultural products constituted 38% of the total national income. This figure has now dropped to 23%. The figure for industrial products, on the other hand, has increased from 15% to 23% in the same period. Thus, in 1977 the total shares of agriculture and industry in the national income were about equal.

Natural resources include large quantities of minerals, such as chromium, copper, boron, manganese, zinc, iron, wolfram, and sulfur. A recent discovery of rich uranium deposits along the Black Sea shore is under study. Little information is presently available on this subject. In the field of petroleum, domestic crude oil production accounts for only 20% of the total national consumption. The major industries are textiles, cement, fertilizers, iron and steel, copper, zinc, food and beverages, petroleum refining, coal, and borax.

In spite of heavy investments in the past 15 years, Turkey still imports machinery, transportation equipment, iron and steel, petroleum, fertilizers and chemicals, creating a large deficit in the balance of payments. Exports in 1971 corresponded to 58% of imports. As a result of the impact of the rise in oil prices, this figure dropped to 30% in 1977. In other words, foreign trade at the present is creating a 70% deficit in the balance of payments. In 1977 Turkey's import and export figures were $5.8 billion and $1.75 billion respectively. The cost of crude oil and petroleum products imported in the same year reached $1.44 billion.

Ever since the foundation of the Republic some 55 years ago, the main problems of Turkey in industrial development have stemmed from an insufficient number of scientists and technologists, lack of know-how, insufficient capital for investment, and large deficits in the balance of payments. The Republic inherited practically no industry from the Ottoman Empire. This fact can be seen from the number of industrial workers of that period, which was only 11,000 in 1923.

Realizing that the private sector did not possess sufficient capital for investment, the Government began establishing state-owned industries as early as 1930. Little or no control was exercised on the choice of technology, process or product quality. Large investments were made in the fields of cotton yarn, textiles, mining, metallurgy, cement manufacturing, and iron and steel

production. This situation continued until 1950, when the Government began to encourage private and foreign investments. Large numbers of plants were built within a short period. It was a new experience for the public to observe the functioning of these industries, namely the private and the state sectors. They were evaluated with respect to product quality, dependability, price and service to consumers. Today, in contrast to the inefficiencies of most state-owned industries, private plants still operate with high efficiency, good maintenance, modernization, and profit. Within this mixed economy, per capita income reached $1009 in 1977, a figure still too low.

I believe that it is possible to find many similarities between the conditions in Turkey and other developing countries. With this assumption in mind, I would like to point out certain factors relevant to development in general.

Industrial development means different things to a developed country and a developing country. Among the industrialized nations the primary goal is to discover new methods and new products for competition in the world markets. In the developing countries, however, the initial problem has been to build sufficient industry to supply the nation, such that the volume of imports could be reduced. Although in many of these cases, the capacity of a plant required for domestic consumption may not be high enough for economic operation, it is often subsidized by the government and further importation is prevented to give the firm a monopoly in the local market. The need for foreign currency and the ever increasing problem of the balance of payments force these nations to make great efforts on a national scale for self-sufficiency. High taxes, generous educational investments, and export promotions are characteristic among these nations.

It is generally agreed among scholars that only through persistent, productive, and efficient research can such differences between the developed and developing nations be eradicated.

Developing countries may face the following shortcomings with respect to scientific and technological research efforts:

1. Only a small fraction of the GNP, usually much less than 1%, is allocated annually to research and development.

2. The percentage of the population involved in research and development is too small.

3. Although basic research activities are primarily conducted in universities and research institutes, sufficient coordination may not exist between them and the productive sectors.

4. In general, the importance of research and its potential problem-solving applications are neither sufficiently understood nor appreciated by the productive and managerial staffs.

5. Such research work as may be undertaken by some of these organizations is poorly supported.

In order to meet the requirements of economic development and social progress, weight should be given to research in technology, organization, and control, directed to lowering investment and operational costs while increasing output. Support should be given to research whose direct contribution to an increase in productivity cannot be measured but which contributes to economic growth, to research which reveals the features of social progress and increases the effectiveness in the implementation of decisions. Manpower should be trained for economic and industrial development research. Finally, basic and applied research should be supported by both the private and state sectors, becoming more effective by a close cooperation between them. The recognized gaps and shortcomings should be filled through international scientific organizations with concentration on those activities required by the demands of development.

Industrial development in developing countries has been practiced mainly by purchasing manufacturing plants on a turnkey

basis. Thus the cost of design, construction, installation, and start-up is paid by the purchaser. Payment for the know-how and technology transfer constitutes a substantial portion of this fee. Under these circumstances one can hardly expect such a plant to be competitive in the world markets. In fact, their operation is often subsidized by the Government. Imported technology may not be outmoded, but certainly it cannot be expected to be up to date. This method of industrial development, therefore, forces one nation to follow the advancement from behind, never being able to catch up with the technological developments of the advanced countries. In order for the products to be competitive, certain factors such as the availability of raw material and labor must greatly be in favor. Other factors affecting industrial development, product quality, and cost can be listed as follows:

1. Construction of a plant on turnkey basis may take from two to five years for completion. Since capital is scarce and the interest rates are high in developing countries, such a delay may increase the cost of construction by as much as 50 to 100%.

2. The contracting firm has to employ a large number of its own personnel at the construction site. This means the multiplication of normal salaries by a factor of two or three.

3. Training of local technicians, plant operators, and administrators also adds to the total cost.

4. Once the plant begins to operate, maintenance becomes a problem. Experts are often invited for advice and trouble shooting. Thus, local management is dependent on the original contractor until sufficient personnel are either trained or acquire experience.

5. Industrial plants built by foreign firms operate within certain preset specifications. Consequently, they cannot be modified with ease for higher capacity or greater efficiency.

6. Lack of research maintains the original design and product specifications over many years. Meanwhile, the discovery of a new product as a substitute often appears in the market, making the old product obsolete or more expensive. Transistors in place of radio tubes, electronic calculators in place of mechanical devices, and satellite communication in place of cable transmission are some examples of such a situation.

Considering these handicaps, developing countries should adopt a way by which industrial development can be achieved economically and with greater assurance of continuity and progress. It may be suggested that the best way to accomplish such a task is to mobilize the resources of the nation towards the developmental needs of the country. That would entail scientific and technical research with particular emphasis on the efficient and effective utilization of human and material resources.

There are numerous examples of organized research undertaken at the time of development of countries which are now highly industrialized. Agricultural research conducted by the land-grant colleges in the U.S.A. since the second half of the last century has been the primary factor in the development of agriculture and related fields in this country. Basic research in agriculture opened new fields of application and promoted the training of scientists and engineers, not only in agriculture but in other fields as well.

It was mentioned above that industrial development should be achieved economically and with greater assurance of continuity and progress. These considerations led to the establishment of several agencies in Turkey, among which I would like to mention a few:

The Turkish Standards Institute (TSE) was founded within the Union of Chambers of Commerce, Industry and Commodity Exchange in 1954. Its goals were to produce publications in standardization, to establish a library of standards, and to undertake a program of cooperation between the scientific and technical institutions in Turkey. TSE operated until 1960 with a small budget, employing only a few personnel, most of whom

were volunteers. The Institute gained a new status by a law passed in 1960. This law obligated each member of the Union to pay a certain percentage of its annual income to TSE. The buildings and laboratories of the institute were financed by AID. Today, it is well established, performing various functions, such as research in standardization, cooperation with industries, universities, and scientific organizations, preparation and publication of standards, training of personnel, cooperation with the International Organization for Standardization (ISO), and controlling the quality of products which bear the TSE sign as a symbol of conformity to respective standards.

It is well justified to state that TSE has substantially contributed to the industrial and agricultural development of Turkey in the past 20 years. It created a certain discipline and confidence in the domestic and export markets in quality and standardization. Nevertheless, it still has a long way to go before its services are perfected. For instance, in evaluating its present performance, one cannot help noticing the following:

1. In the preparation of national standards the priority question is not seriously considered.

2. Standards are prepared by personnel, most of whom are employed in Universities or Government offices: these people have little or no contact with the industry, not knowing its problems sufficiently or the qualities of the raw materials available to them in the market.

3. The cooperation between various industries in the preparation of standards is not too satisfactory.

4. Even in the preparation of national standards, similar standards of other nations are consulted. Little thought is given to the question of adaptability. This has created numerous problems, particularly in the standardization of agricultural products.

5. The present procedure of certification is inadequate and misleading. Any product which bears the TSE sign meets the minimum level of quality set by the relevant standard. There may be several products, all meeting this level of quality but one superior to the others. The TSE sign, however, makes no distinction among them.

6. Quality checking of product specifications at certain intervals for certification is not handled efficiently due to insufficient personnel and funds.

For many years TSE has tried to establish a metrology laboratory but has not succeeded. This is creating a serious weakness in the technical facilities available in the country. Without a properly equipped and maintained metrology laboratory, many of the existing technical facilities in Turkey are jeopardized, I should say, paralyzed, in certain cases. For instance, correlation of measurements at national and international levels is difficult and expensive. It should also be noted that without a system of calibration, certification in the international markets would have no value because the accuracy of the measurements cannot be guaranteed. Similarly, in the application of legal metrology (laws pertaining to weights and measures) and the determination of tolerances, a metrology laboratory becomes an absolute necessity. There are, however, differences of opinion in Turkey on where this laboratory should eventually be located. Since it requires extreme care and precise control (humidity, temperature, etc.), also a highly qualified technical staff, TSE may not be the proper place to handle the job. As an alternative, the research center of the Scientific and Technical Research Council of Turkey (TÜBİTAK), located in Istanbul, may be a more appropriate place for this laboratory. It is also hoped that with the contributions of its technical and managerial staff, the proposed metrology laboratory may someday develop into a National Physical Laboratory within this organization.

The State Planning Organization (SPO) was established in 1960. Attached directly to the Prime Minister's Office, SPO undertakes comprehensive development planning in Turkey. It is guided by a High Planning Council chaired by the Prime Minister. SPO has three

principal divisions: the Social Planning Division, the Economic Planning Division, and the Coordination Division. They prepare and follow the short and long range plans known as the Five-Year Development Plans. So far, three such plans have been concluded, a fourth is under application.

Public Sector Investment Projects, whose number may reach as high as 100,000, Special Projects involving large capital investments, and other development and industrialization projects, are studied and evaluated by SPO. When selecting different project proposals, particular emphasis is placed on the income effect, foreign exchange effect, employment effect, correction of consumption patterns, production costs compared with import prices, and the effect of regional impact. No technological selection or assessment of the technology factor is performed, however. Results of these studies are published in the annual programs. At the beginning, SPO was given also the responsibility to offer training courses for people responsible for the collection of information for evaluation purposes during and after project implementation. This responsibility was later transferred to the State Investment Bank.

At this point I would like to mention one project which is relevant to this Seminar's topic. SPO was selected as the Government's implementing agency for a three-year project, undertaken by the United Nations Development Program (UNDP) in Turkey, titled "National Quality Control System". This project, which started on 15 November 1977, has the following development objectives:

"To assist the Government of Turkey in the establishment and operation of the appropriate and legal, institutional and technical infrastructure needed to further improve the quality and reliability of goods and products manufactured and produced in Turkey, with a view to promoting and ensuring a greater acceptibility in the international and national markets."

The project will also assist in developing quality consciousness among industrialists and producers; in introduction and implementation of effective quality control in industrial plants; in developing the closer integration of the national activitie in standardization, quality control, and quality certification; in improving the technology of manufacturing processes, thereby developing greater national technological capability and self reliance; in providing training in quality control to the personnel for production and management.

Needless to say, this project will greatly contribute to the development of Turkey in a long-neglected field, quality control (QC). The current study in this project is seriously handled, aiming to establish a National Quality Control System. It is facing, however, certain difficulties which originate from the following facts:

a. To create an effective QC System for the entire country, a great variety of factors must be taken into consideration.

b. There are numerous Government organizations, institutions, municipalities, and others who have some responsibility under the present law related to the quality of a product.

c. The range of products to be covered is not limited; thus, the range of technologies to be catered to is also unlimited.

It is also believed that the ultimate success of the proposed system of quality control will depend on its constant refinement and development in the light of practical experience and changing circumstances.

A preliminary survey carried out by the UNDP experts in connection with this project revealed that "the concepts of industrial quality control are not fully understood by most industrialists nor by many of the official and semi-official organizations. There is the mistaken idea that inspection and testing of the product constitutes quality control. Only in the more sophisticated industries and then, usually, only where there has been some foreign influence, has there been any attempt to organize effective QC systems, internally within manufacturing plants. As a result, there are no trained or experienced QC personnel in anything like the numbers which

would be required for industry in the event of a rigorous policy for in-plant QC being pursued by a national QC system."

Returning now to the activities of the State Planning Organization, it is justified to state that this organization has been successful as an effective central planning authority. Although certain influence on policy decisions from outside can always be expected, since its direct involvement in project implementation was cancelled in 1971, it has managed to function as an advisory and investigatory body quite independently. SPO always emphasized the need for quality control, standardization, documentation, metrology, and packaging.

During the first Five-Year Plan Development Plan (1962-1966) the lack of any policy-making authority for scientific and technological research was recognized. As a result, the Government decided to establish the Turkish Scientific and Technical Research Council (TÜBİTAK) in 1963. I would like to mention the activities of this Council, particularly for its contribution to development and technology transfer. TÜBİTAK, like the SPO, is attached to the Prime Minister's Office and is, therefore, independent of other Ministries. The Establishment Act states that "TÜBİTAK' shall be the central authority responsible for assisting the Government in formulating a national policy for research in the fundamental and applied sciences and for formulating education policy in the scientific field." Thus, TÜBİTAK has been given power and an open mandate to promote and carry out research activities for this purpose. Since its foundation, the Council has undertaken the mobilization of existing research potential, strengthening of the institutional structure of Turkish science, providing facilities for information and communication to Turkish scientists. Within this program TÜBİTAK established three research institutes, a number of research units in various institutions, and the Turkish Documentation Center. It supported scientific meetings and provided scholarships at different age levels, mainly for the training of future researchers.

Scientific and technological research laboratories are located in Gebze near Istanbul. Studies requested by the industry are evaluated for their importance and fields of application. In this respect the laboratories operate in a fashion similar to that of TNO in Holland. Bench scale and pilot plant studies are carried out for process development, use and evaluations of raw materials found in Turkey, and trouble shooting. Automatic control and computer applications are also introduced to the industry.

According to TÜBİTAK, technology generation in Turkey is at a preliminary stage. Although the adaptation of technology has a special importance in development, there is no institution in the country controlling this process. Meanwhile, technology transfer is being carried out by individual organizations without any coordination among them. Even if these organizations would favor such a coordination, the unification of the existing laws and regulations would be difficult.

Today I have heard a number of our colleagues speak on technology transfer. I have a different view on that. Because technology transfer is not handled on a more generous basis, it seems that industrialized nations are being accused to a certain extent. But, after all, it takes a lot of money and effort to develop a new process, a new product, or a new method; and an organization is not expected to hand this over to others without a profit. It is a business proposition. If they have perfected something, they have the right to sell it. I remember that the DuPont Company invested more than $60 million for the perfection of nylon. Or the purification of materials in the production of transistors was a very expensive proposition. Why should they give this knowledge, after working on it for years and spending so much money to others without anything in return? A company has to consider its own profit, and never jeopardize its own interests. We have to realize that. If we cannot get this operative technology as we wish, it's not their fault. It's our fault, that we have not handled this research ourselves, or we are not willing to afford, or to pay a sufficient amount to such firms.

TÜBİTAK considers that in the transfer of technology, for products to be eventually exported, up-to-date technology should be imported, for competitive reasons, while for items of local consumption, there is no need for such up-to-date technology. Instead, a labor-intensive technology should be substituted. Again, I do not agree with this. Just because the developing nations have an employment problem, there is no need to go back and choose a technology which is not up to date, which is not modern, for the sole purpose of employing more people. I remember that in 1954-1956, in the United States, too, there was a lot of argument on the switching to automatic control systems. Many of the labor unions objected that this would cut down employment. Nevertheless, it was very successfully applied, and today there are petrochemical plants miles long, where you seldom see a worker working outside. And there are no objections from the union or the management, and everybody is happy. I am sure that by importing up-to-date technology, even for products for local consumption, developing countries should be well ahead, and definitely in a better position than by importing an old technology for the sake of employing more people.

One thing is definite, that license agreements should be prevented as much as possible, simply because the seller of a license puts a lot of restrictions on the process. For instance, you have to buy all of the raw material from the licensor, and you are often prevented from exporting any of the product. Also, the patent rights which may result from the purchasing of this license are often confiscated by the licensor.

However, for the sake of the record, I want to note that TÜBİTAK believes that:

a. The policy of technology transfer should take into account the distinction between products for export and those for domestic consumption. For export products, the imported technology should be so advanced as to enable competition at the international level. For the products for domestic consumption, on the other hand, labor intensive technology should be preferred to enhance employment.

b. For items of domestic consumption, there is no urgent need for technology generation, since many of such industries face little or no problems in this respect. However, certain selective industries, such as the processing of a raw material available within the country, may require technology generation.

c. For technology transfer, an effective coordination is necessary among the Ministries and agencies involved in decision making and implementation. An organizational setup is needed for searching, collecting, storing, and retrieving information on technology transfer. Studies should also be directed to determine the existing technological potential and technology generating activities.

A brief survey was undertaken to determine how technology has so far been transferred to Turkey. The results reveal that license agreements for processes and patents, importing of machinery and equipment, foreign investments, exchanging of experts within technical cooperation programs, and obtaining of information from books, journals, and other printed documents constitute the basic modes of technology transfer.

From the considerations stated above, it is obvious that the developing nations must import technology from the industrialized nations until they reach the level of generating their own technology. Before deciding which technology to import, these nations must have adequate and reliable information in their hands. They are often confronted, however, with restrictions imposed on the technologies by their proprietors. The decision making, too, becomes a difficult task, as there is certain reluctance in accepting the new and modern methods. Developing nations still consider such modern technologies as luxurious, unnecessary, and often in conflict with their employment policies.

In the license agreements, too, certain conditions are often imposed on the recipient (licensee) by the supplier (licensor). These

may be restrictions on the exporting of goods produced according to that particular license, an obligation to import all raw materials from the licensor, acceptance of a package deal (turnkey project), or confiscation by the licensor of all patent rights which the licensee may acquire as a result of the application of that particular license.

The National Productivity Center (NPC) is another organization, established by law in 1961, to perform studies and do research to increase productivity in industry and agriculture. NPC organizes seminars and workshops to train managers and the personnel employed in industry and agriculture. New techniques and methods are introduced in these seminars. Work study (time and motion study), quality control, value analysis, value engineering, ergonomics, marketing and productivity measurements are heaviy emphasized. Performance analyses are carried out in industrial centers, and methods are demonstrated.

After the National Quality Control System is established, the National Productivity Center is desired to take an active part in the System. A Productivity Officer at each regional and district office is expected to instillthe idea into the minds of managers, supervisors, or others concerned with production, that effective in-plant QC can achieve considerable gains in productivity. This officer will develop personal contacts with industrial communities in his area, visit managers in their factories, organize in-plant seminars, arrange for groups of employees from different factories to meet and discuss common problems, organize Productivity Groups, QC Discussion Circles, QC Local Associations, Management Debating Groups, etc.

Although there are other organizations contributing to the National Development, they are less important and will not be mentioned within the limited space of this report.

In summary, Turkey has made great efforts for development, particularly in the past 25 years. People, considering industrialization as a national duty and a matter of national prestige, sacrificed a lot for its success. For instance, even the middle-income people have been paying taxes from 35% to 58%, a rate highest in the world. Factors preventing rapid progress have been insufficient capital for investment, large deficits in the balance of payments, rising oil prices, and the lack of know-how.

It should also be confessed that mismanagement and poor cooperation among various agencies prevented a higher rate of development. This is usually the case in developing countries, where available potentials are not efficiently used due to bureaucracy, poor quality of management, and lack of cooperation. Therefore, the establishment of a new institution to perform a certain task in a developing country is not sufficient to achieve the desired goal. The main problem lies in the proper administration and the proper incorporation of this facility within the development complex. These facts are often learned by experience, either too late or after much money and effort have been wasted.

Now, what should be done in a developing country to expedite the rate of development? What are the methods and procedures one can expect? I personally think that it is most important to create conditions in which a continuous development can be achieved. In other words, we have to make sure that the conditions we create in the country open the way for industrial development. For instance, heat would flow, if you had a temperature difference. Mass would flow, if you had a concentration difference. Or electricity would flow, if you had a voltage difference. So, what difference should exist, or what are the conditions, by which development can be achieved in such countries? I believe that this potential is the education level, both in theory and practice.

Of course, science and technology or research in basic sciences, education in basic sciences, and application in engineering, should be well balanced. Many people consider scientific education unnecessary, in a way, for developing countries, because, they claim, the country is not at the stage

where sophisticated theories of science should be brought out. I am of the contrary opinion. For instance, Russia has progressed very rapidly, not because of its system, because even during times of the Tsars in Russia, there was a very high level of science. They had perfected elasticity theory, for instance, by 1912, and they were far ahead in mathematics, physics, and chemistry, compared to many of the Western nations. The Tsars made a habit of inviting top scientists to Russia. For instance, the genius in hydraulics, Bernoulli, was paid a high salary to come to Russia and do research, and they succeeded in that. They almost succeeded in getting Gauss, the famous mathematician, but the German government was smarter, to keep him there.

A few years ago, we had a meeting, in Africa, in a developing country. A friend suggested that they should train technicians to build roads. Just as a suggestion, I mentioned that in the training they should include also certain principles pertinent to road construction, such as adhesion, cohesion, porosity, weather effects, the composition of tar, oxidized tar, etc. I was bitterly attacked by the people, that this was not creating an atmosphere by which this country should develop. And, they decided that they should just ask the people how to lay the stone and to cover it with tar. I'm sure today, those roads either do not exist, or require a lot of repair, because people applying a certain technology should be well aware of the scientific background before they try to apply it. And I do believe that today's theory is definitely tomorrow's application.

So, in conclusion, while many people suggest practical education in a developing country, I believe that such a limitation on education prevents rapid development. In a developing country education should be well balanced between theory and practice. A sound training in basic sciences assures continuation of progress.

Government investments in industry and business in the developing countries should be discouraged, simply because any enterprise so created is generally inefficient, over-staffed, and unprofitable. Private enterprise, on the other hand, proves to be more efficient with greater assurance to expand in time. Since capital is scarce in a developing country, people should be persuaded to participate in industrial investments by purchasing shares. It should be noted, however, that the rapid devaluation of money in developing countries, which is so common, makes certain investments, like in real estate, more attractive. Accordingly, the government should take proper steps in taxation to prevent such speculations and to direct investments towards industrial development.

Foreign investment in a developing country requires careful selection and implementation. Protection of the national interests at the utmost level has to be considered before deciding what areas and technologies require or even tolerate foreign investment.

There is an immense desire in most developing countries to import sophisticated machinery, computers, and other fancy equipment. This tendency often constitutes a waste and should be prevented. The efficiency of complex machinery is generally low due to the lack of properly trained technicians.

Two years ago I visited a machine shop in a developing country. The machines they were using were of high quality, all computerized, etc. I asked about the value of the investment they had made, and also calculated what possible return they could get. It was less than 1%. So what is the use of importing such expensive machinery, which will eventually result in a very small return, except for a good show to political people?

You will all remember that at the end of the Second World War, England and Germany used machinery which was quite obsolete at the time. Nevertheless, until they had developed their industries and had developed sufficient capital, they had to resort to using such out-of-date machinery, and they have been successful.

I think that work or working should be appreciated by workers, and that they should be disciplined. Now, a certain discipline

comes from the level of industrialization of a country. I have seen many workers in Turkey who have been expelled from their plants, because they were not doing their job properly. They went to Germany (by the way, we have more than 500,000 workers in Germany). There, they have been very successful, and their employers have been well satisfied with their performance. Now how we can create that atmosphere and the feeling that a worker considers himself part of that industry, is something to be considered.

I also believe that industrialization and development should be introduced at early stages, for the school teachers and students in primary schools, for instance. I admire certain examples that I have seen. For instance, when I was at one time working in Niagara Falls, I would see a young boy selling newspapers early in the morning. It was months later that I found out that he was the son of the director and owner of the plant. In many developing countries, if the boy is the son of a rich man, it would be thought shameful for his father to put him to work. Now, this idea should change. This morning, it was interesting to hear about the progress in Korea. The primary reason for that progress was *work*, *hard work*, nothing else. Unless we are willing to work, unless our children are willing to work, then no one can look with confidence into the future.

The young generation in a developing country should be taught to appreciate working without shame or embarrassment. This philosophy should be introduced at the primary school level. Unfortunately, the underdevelopment of many countries originates from the idleness of their people and the complete dependence of the youngsters on their parents even after completing their education. Desire to work and the sense of responsibility for the development of their country by working must be introduced among the rich and the poor as well. I would also suggest that the inheritance tax in a developing country should be very high for the same reason.

In the developing countries, labor unions and management should be protected by laws. No one of these two should dominate the other. And in the preparation of laws and regulations, I think that the national interest should be the prime consideration.

I strongly believe that industrialized nations should take a greater interest in the development of developing nations. There is needed a new agency to assist these nations in technology transfer, quality control, standardization, metrology, certification, and marketing. The proposed agency should form a triangle with International Monetary Fund and World Bank, to contribute technical and managerial assistance in the realization of industrial development projects. The same agency should even continue its work several years after the project is fully realized. I would also think that every such project with modern technology and management would constitute a new example to the already existing agencies and industrial plants of that developing nation. Thus, they will learn the easy way by observing each time a new example for their own improvement and modernization.

DISCUSSION:

Dr. Robert W. Middleton (Assistant Secretary General, International Organization for Standardization, Geneva, Switzerland):

With respect to your last comments, your suggestions with relation to the World Bank, I would like you to know, as a matter of coincidence, that I happen to have an appointment next week with the World Bank to discuss a project very similar to that which you have suggested.

PAPER 6.2 - EXPERIENCE OF AN INDUSTRIALIZING NATION IN DEPLOYMENT OF TECHNICAL KNOWLEDGE TO MEET NATIONAL NEEDS

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1. TECHNOLOGY, ITS TRANSFER AND ADAPTATION

The Industrial Revolution is now entering a most promising and complex phase as it becomes global in scope. Presently, at least 77 countries in Asia, Latin America, Europe, and Africa, containing about two-thirds of the world's population, are in the industrializing or semi-industrialized stages of development, including a few that are still building up the physical infrastructure. Most of these nations are newly independent and intent on shaping strategies of industrialization suitable to their own goals, needs, and values. These national orientations are to be matched with a world situation in which the international mobility of technology and resources is creating new forms of interdependences among nations. Technology, in the sense of the practical application of invention or discovery, is as old as mankind itself. What is new is the science-based technology or high technology, the outcome of industrial research, a phenomenon of the present century. Accordingly, there has been a considerable urge to transfer this technology to the lesser developed countries in the last 50 years or so.

The term *technology* has been variously defined, but I am sure that we all realize that in general terms *technology* is supposed to do things for people, and *should* bring benefits to the people at all levels, especially to provide progressive self-reliance, if it is to be any use in the long run.

The total flow of technology to any one country can be considered as the sum of the imported technology and the local technology. By itself, each is incomplete. The latter is a minimum in the so-called "turnkey" jobs, with hardly any transfer of technical information or basic technological skills. However, even the more sophisticated countries have had to import science or technology, or both, at various stages of their development. And it is in fact a mixture of direct importation with a considerable measure of what is known as vertical technology transfer that seems to give the optimum development. This involves grafting of suitable unembodied technology, that is to say, the know-how rather than the actual machinery, onto the existing technical base in the developing country.

In agriculture, the application of modern know-how necessarily involves adaptation to suit the soil, climate and other aspects of the specific environment, e.g., improved rice-growing techniques must ultimately be tailored to fit the particular conditions of a particular area. While there have been some striking successes in this field, it is fair to say that present efforts (over the developing regions as a whole) have been largely concerned with only a few major grain crops, grown under irrigated conditions. Application of even these results of adapted technology has *not* necessarily brought socially equitable results, as they have usually tended to favour the larger farmers; but this apart, many important fields are still neglected in cultivated agriculture, while as a rule little attention has been given to applying modern technology to animal husbandry, forestry, and fisheries.

Nevertheless, the need for proper adaptation of imported technologies in agriculture is *generally recognized*. But in industry and in large-scale construction projects, the situation has been rather different. Here the tendency has been towards the wholesale introduction of technology from industrialized countries in packaged form, often as turnkey projects. Typically, this direct or "horizontal" transfer of technology

* The views expressed in this paper are the author's own and not necessarily those of the Appropriate Technology Development Organization.

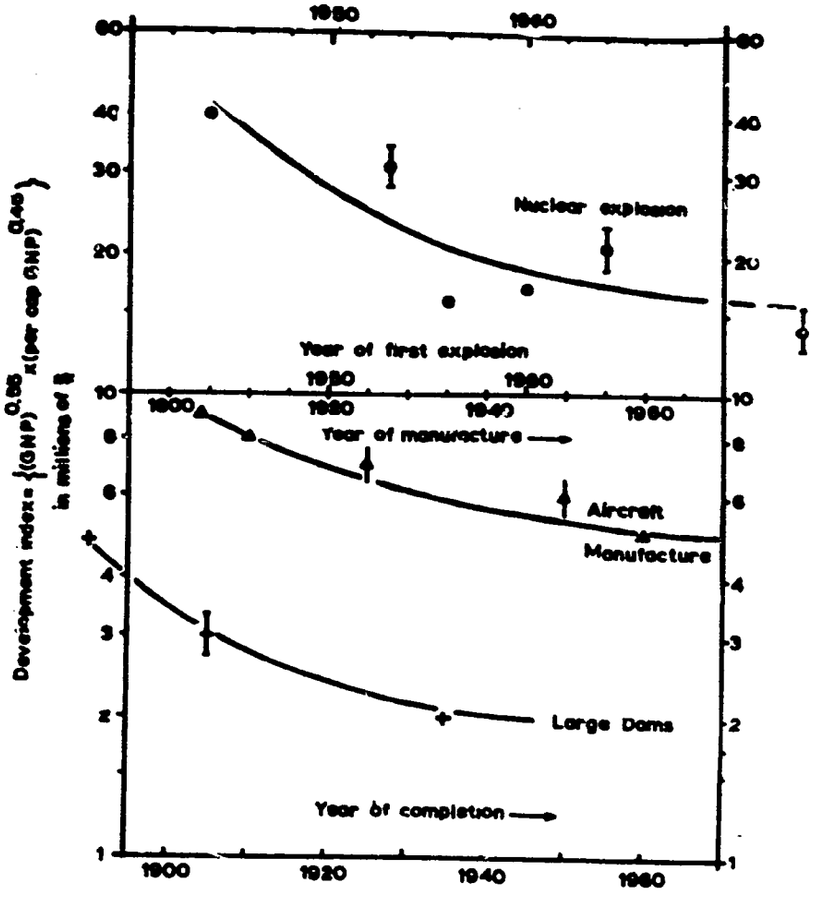

Figure 1. Development Index versus Year of Technological Achievement, for Nuclear Explosions, Aircraft Production, and Building of Large Dams.

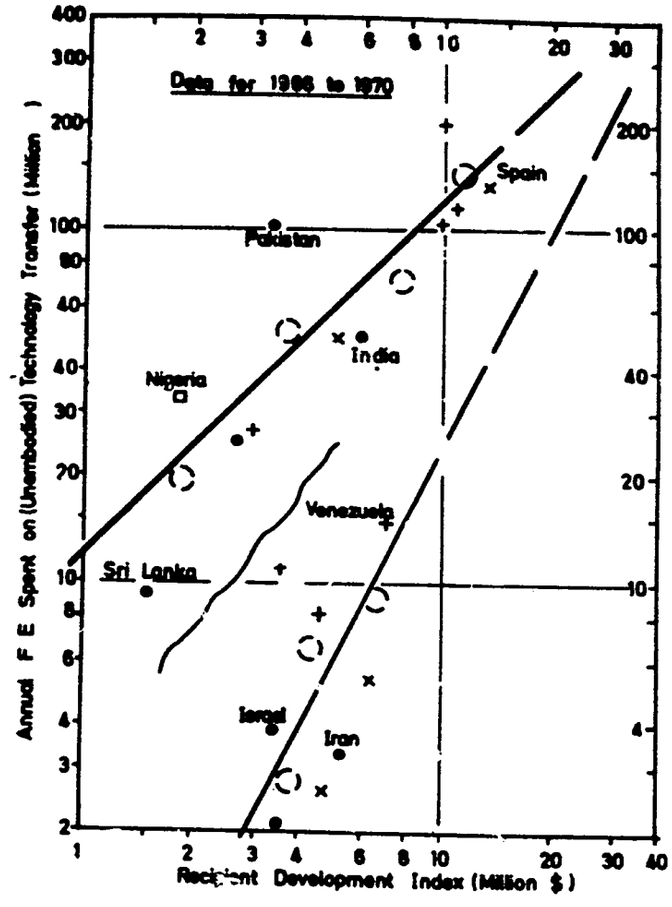

Figure 2. Annual Funds Expended on Unembodied Technology Transfer versus Recipient Development Index

is associated with some measure of foreign equity participation, which may in itself make for difficulty in adapting any part of the package to meet local conditions. The modern sector thus built on simple transfer of the industrialized countries' technology has tended naturally to be capital intensive, labour saving, and dependent on imported machinery and chemicals.

2. TECHNOLOGICAL CAPABILITY AND TRANSFER INDICES

In a paper that I published a few years ago [1], I was able to describe and formulate a "technical development capability" index, in an effort to define what sort of project any developing country could reasonably take up with some hope of success (see also Appendix A). This question is important, because all of us are trying, for various reasons and in response to several pressures, including political pressure, to become more and more sophisticated in our technology. And if you try to transplant something that is too sophisticated, it just doesn't fit, it doesn't grow. The Technological Development Index is to a first approximation given by the square root of the GNP multiplied by the square root of the per capita GNP. A slight refinement of this was worked out in a later paper, and this gave very interesting results.

Following on from this, I was able, with the help of certain data and discussions with various colleagues, to work out a very simple formula, showing the total quantity of technology transferred into a given country, from one country "A" into a country "B", and how that depends on the same type of index. In fact, I was able to show that the total quantity of technology transfer, which you might evaluate by the amount of money spent on the imports of technology that is transferred, is given by the product of the development indices of the donor and recipient countries. Obviously, technology transfer is a function of both. For instance, if the recipient is totally incapable, there is hardly any chance of effective transfer.

[1] M. M. Qurashi, Proc. Pak. Acad. Sci. 11, 9 (1974).

Figures 1 and 2 give some idea of the kind of thing that I have just been describing. On the left hand side of Fig. 1 is plotted the technical development capability index, against time over a 50 year period, for the first achievement by various countries of three types of technology: (1) building of large dams, which is perhaps the simplest sort of technology, because large dams were built centuries ago, in some cases; (2) the manufacture of aircraft; and (3) nuclear explosions. The value of the index decreases with each successive repetition of the particular process, and comes down to roughly 50% of the starting value. The first country which built aircraft had to have a very high level of development, but those who copied it later on required a much lower value of the index, and the same applies to nuclear explosions. This indicates that borrowing technology does give you a certain advantage. In other words, you are able to do that particular kind of project a little earlier than you would be, if you were developing on your own.

Figure 2 shows the application of that same type of formula to the total expenditures on technology transfer, which is shown on the vertical axis, against the development index of the recipient. The development index of the donor averages out if you consider that there are only five or so large donors of technology in the world -- the U.S., USSR, UK, Japan, Germany, and perhaps a few others -- and you can take the average of those, and multiply by this constant factor. This graph, for which the expenditures go from about $10 million per annum up to about $400 million per annum, does provide a fairly reasonable sort of linear relationship on a log-log scale. What is interesting is that there are two types of country, the type on the upper curve, which corresponds to countries which have no highly valuable resources like oil, and the countries on the lower curve, which are the oil producers. Both of these curves come out of the formula. The formula is to my mind what one might call the First Principle of Technology Transfer, in that there is a relationship between the state of development of the recipient and the amount of technology that it is capable of absorbing through transfer.

This particular type of formula is also true in time, that is to say, the formula will give equivalent results when applied to data

Table 1: Analysis of Pakistan's expenditure on import of technology from 1955 to 1975.

No.	Item	1st Plan 1955-60	2nd Plan 1960-65	3rd Plan 1965-70	4th Plan 1970-75
1.	GNP (Rs. x 10^9)	28	39	70	95
2.	Annual Dev. Plan (Rs. Million)	2,500	6,000	9,500	12,000
3.	Foreign assist: ($ million)	200	470	540	450
4.	Expend. on import of techn. ($ million)	65±10	140±40	220±20	220±40
5.	Total expend. on techn. transfer	75	160	280	340
6.	Develop index for Pakistan ($ million)	1.4	1.9	3.2	4.6/3.5
7.	Mean dev. index for 5 donors ($ million)	33	43	55	70
8.	Tech. transfer index ($ million)	46	82	176	245
9.	Factor of proportionality	1.6	1.9	1.6	1.4

over a period of 10-15 years, at least for the case of my own country, as shown by a comparative assessment of the total amount spent on technology transfer in various Development Plan periods. If we take this amount to be the sum-total of the imported "embodied" and "unembodied" technology, we can make estimates of this expenditure in two different ways, viz (i) as 4/3 times the cost of machinery imported in any one year, so as to include all patents and technical services, or (ii) as 40% of the total foreign assistance provided in any one year. The averages of these two estimates are given in the fourth row of Table 1, together with the probable variation [2]. To these we may add the gradually increasing value of machinery manufactured within Pakistan to arrive at the total annual expenditure on technology transfer as given in the fifth row, which exhibits a 5-fold increase from $75 million in the First Plan period up to $340 million in the Fourth Plan period. This is in almost exact proportion to the value of the technology transfer function which is calculated in the eighth row. Taking $ million as the unit in all cases, the mean value of the factor of proportionality is seen from the ninth row of the table to be 1.6, with a variation of only ±10%, which provides further evidence for the validity of the theoretically derived technology transfer equation.

[2] "The Fourth Five-Year Plan (1970-75)", Govt. of Pakistan, Islamabad, and related documents.

3. ECONOMIC AND TECHNOLOGICAL DEVELOPMENT OF PAKISTAN

In Pakistan, technological development can be said to have commenced somewhere in the early 50s. We have had four five-year plans. During these plans, there was a concerted technological development effort made by our national planning organization (currently known as the Planning Division of the Government). This began by simple horizontal technology transfer -- that is, imports of machinery and experts -- in the first plan period, and gradually over the subsequent three plans, the emphasis was shifted towards vertical transfer, with more and more of the know-how being obtained and less and less of the actual hardware.

The traditional major raw material resources of the original Pakistan, which included both the present Pakistan and what is now Bangladesh, were cotton, leather, sugar, and, of course, jute. And there was a certain amount of indigenous expertise existing in woodcraft and metal-working. Accordingly, we find that in the first ten years, there was a considerable growth of cotton textiles, and of some of the food product industries, e.g., the sugar and hydrogenated oil industries. During the third and fourth plan periods, there has been a consolidation of the manufacture of cement, and a slow development of the fertilizer and soda-ash manufacturing industry (See Table 2.).

Table 2: Manufactures of Pakistan

Product	Unit	1949-50	1959-60	(1964-65)	(1969-70)	1974-75 (est.)
Cotton textiles						
(a) Yarn	Million Lb	43	403	(520)	710	800
(b) Cloth	Million Yards	99	606	--	810	7700
Jute textiles	Thousand tons	--	250	(340)	600	--
Vegetable Ghee	Thousand tons	3	30	(90)	160	250
Sugar	Thousand tons	36	144	(310)	460	500
Fertilizers	Thousand tons	--	51	--	370	300
Soda Ash	Thousand tons	--	27	(28)	45	--
Cement	Thousand tons	417	1027	(2000)	2700	3,000
Machinery	Million Rs.	N.A.	N.A.	N.A.	297	500

As a result of the rapid growth of the industrial sector, combined with the introduction of incentives like the export bonus scheme, the manufactured exports increased at an average rate of 20% per annum in the 1960s and accounted for over 60% of merchandise exports in 1970. A substantial part (about one-quarter) of the industrial development was a consequence of aid, mostly in the shape of loans, and the ratio of debt-service to exchange earnings was nearly 20% by 1970. Although the climate for foreign assistance deteriorated after 1965 at a time when Pakistan's commitments for developmental outlays had grown substantially, the industrial growth continued with appropriate adjustments of development priorities to produce industrial machinery, fertilizer, and transport equipment, mostly at the expense of the social sectors.

We can form a useful picture by looking at the development expenditures in the various sectors, during the first three Plan Periods extending from 1955 up to 1970, and assessing the results produced in the form of exports and manufactures for internal consumption, as against the imports (Tables 3-5). The heaviest development outlays have been in manufacturing, water and power, and transport and communications. It is readily seen that there are now sizable exports of cotton cloth, cotton yarn, footwear and leather goods, while nearly sufficient sugar and vegetable ghee are being manufactured to meet the local demand. Over 5% of the GNP is in the small-scale manufacturing sector. These fields all involve essentially traditional technologies, which have been modernized and the efficiencies of which have been improved considerably with the help of imported technology. In most of these, the technology import has been of the unembodied character, that is to say, the know-how has been obtained, and most of the hardware is now being made in the country itself. For instance, a good deal of sugar processing machinery is now being manufactured in the country, and, in fact, small size sugar manufacturing plants are being exported from Pakistan today.

In the field of fertilizers and chemicals and machinery, the expertise is growing, but here there seems to have been rather less of the vertical technology transfer. There has been a rather unfortunate incidence of large factories put up with the latest know-how, and we are not always able to produce the finished product at actually competitive prices.

In reference to the overall picture over the last 25-30 years, I have tried to make a broad analysis. I have found that there are certain authors who maintain, notably Zahlan [3] from Lebanon, that a twelve year period is required for bringing about a socio-economic change. And it is rather interesting that when I looked at the data for Pakistan (and possibly the same kind of

[3] A. B. Zahlan, Paper read at Seminar on the "Impact of Science on Society" at Islamabad University, 1974.

Table 3: Public sector development expenditure in various sectors (Rs. Million)

	First Plan 1955-60	Sec. Plan 1960-65	Third Plan 1965-70	Fourth Plan 1970-75est.
1.Agriculture	806	1,856	2,811	6,695
2.Manufacturing	1,018	1,305	2,331	4,418
3.Mining	166	321	510	577
4.Water develop	1,373	5,476	6,458	10,125
5.Power develop	742	1,775	3,507	5,840
6.Transport and Comm.	1,590	3,072	4,312	7,905
7.Housing and Phys. Planning	690	1,666	1,636	3,795
8.Education and Training	380	912	1,328	3,665
9.Health and Medical Services	146	381	638	2,445
10.Works programmes	--	650	1,136	2,450
11.Other (small) programmes	9	95	480	1,085
Total	6,929	17,059	25,147	49,000
Per annum	1,400	3,400	5,000	9,800

Table 4: Structural changes in GNP (as percentages)

Sector:	1954-55	1959-60	1964-65	1969-70	1974-75
Agriculture:	56.5	53.2	47.8	44.9	
Manufacture:	7.0	9.3	11.4	12.7	
--Large Scale	1.5	3.8	6.0	7.3	
--Small Scale	(5.5)	(5.5)	(5.4)	(5.4)	
Services:	33.3	37.5	40.9	42.5	
per cap. GNP(Rs.)	283	318	450	560	~600

Table 5: Exports and imports

A. Exports (Rs. million)

	1964-65	1969-70	1974-75 (Est.)
I. Manufactures			
Cotton cloth		270	450
Cotton yarn		270	350
(Jute products)		810	--
Footwear leather and products		200	350
Others		350	750
Total manufactures	1,200	1,900	1,900
II. Primary			
Cotton		215	250
Rice		85	300
(Jute)		780	
Others		270	300
Total primary	1,200	1,350	850
Grand Total	2,400	3,250	2,750

B. Major imports (Rs. million)

1. Machinery	1,760	1,200
2. Steel	742	1,100
3. Fuel and minerals, including chemical fertilizer.	455	600
4. Chemicals	520	400

picture may emerge from examining the economic data for other countries), the first twelve years were those in which technology transfer was almost entirely a simple horizontal transfer with very little infrastructure being built. The second twelve years were the ones in which the most rapid and the most satisfactory growth took place in the economic and technological fields. In these twelve years technology transfer was essentially of the vertical type, and there was a considerable portion of it which was integrated into the local effort. There was a certain amount of training being provided, both at our own Institutes and under some technology transfer agreements. But, when we come to the third twelve year period, which we are now passing through, there seems to be something that has gone wrong. In fact, what has happened, one of the things that is clearly visible (see Table 6) is that the growth of higher scientific manpower has far out-stripped economic and technological growth. This is to some extent symptomatic of many of our developing countries.

Of the 73,000 scientists and technologists in Pakistan, about 1/3 may be B.Sc's, while nearly two thousand have a Ph.D or equivalent. Comparison with other countries on the road to development shows that more and more emphasis needs to be placed on the production and utilization of engineers (e.g., in Turkey, where the number of engineers is nearly equal to that of the scientists). This requires a small increase in the science degree enrollments, but a *substantial* increase of 2- to 3-fold in the enrollments of engineering degree courses if the situation in Pakistan is to be rectified over a span of ten to fifteen years.

Using international criteria, e.g., the UNESCO-CASTASIA model, applicable to countries like Pakistan, it could be estimated that at least 115,000 professional staff should be made available by the end of 1981, of which the breakdown would perhaps be 95,000 scientists and technologists and 20,000 engineers against the existing figures of 73,000 scientists and technologists and 12,000 engineers.

However, what has actually happened is that the industrial and technological opportunities have not grown recently at a rate commensurate with the increase of scientific and technical education, thus leading to disillusionment and unemployment of trained manpower. At the same time, the lack of a strong local R and D and quality control infrastructure prevented the transferred technology from becoming self-sustaining in any real sense of the word, and so we lag behind. Heavily involved in this situation is the tendency in developing countries to seek a white-collar

Table 6: Growth of education, technical manpower, and GNP in Pakistan from 1950 to 1975

Year	GNP Billion of Rs.	Per Capita GNP (Rs.)	Educational Enrollment (Million)	University Enrollment	Engin. Degree Enrollment	Technical Diploma Enrollment	IN EMPLOYMENT		
							Science graduates	Engineering graduates	Technicians
1949-50	21.5	253	4.2	3,000	1,000	900	(35,000)	(7,500)	(10,000)
1959-60	31.4	.318	6.4	8,000	2,400	3,700	50,000	9,000	15,000
1969-70	74.3	567	13.7	30,000	8,300	18,000	90,000	12,000	30,000
West only									
1969-70	38	580	5.7	15,000	5,000	9,000	50,000	7,500	20,000
1974-75	45	600	8.5	18,000	6,000	13,000	73,000	12,000	40,000

education which will lead to the kind of job where you don't have to dirty your hands, so much so that we find engineers from some of the developing countries who, when they go abroad, just don't like even to go near a lathe, or to handle any of the tools of their trade. This is something which one needs to look at very carefully, even though it is true that the more technological education you have, the more rapid growth is *likely* to be, as shown later in this paper from three case studies (USSR, Japan, China).

This general situation is an example of the second important result of experience, that it has been repeatedly found during the last two decades that, in spite of all the transfer of technology, the gap between the developed and the developing countries has consistently been increasing. So, we may generalize this into the Second Principle of Technology Transfer to say that technology transfer *alone* cannot bring any developing country up to a level with the developed or donor countries. In fact, to bring developing countries up to the level of developed countries, several important factors other than simple technology transfer must be considered.

4. THREE CASE HISTORIES

In the cases of Japan and the USSR, there is a very clear parallel between the increase of higher scientific and technical education and the economic growth of the nation. First, let us take a brief look at some of the statistics for the USSR from 1914 to 1964, as brought together in the following Table 7 based on "Soviet education" by Nigel Grant and other sources. It is at once evident that, whereas there has been a seventeen-fold increase in the total enrollment in educational institutions in 45 years, giving an average factor of x1.8 per decade, the corresponding increase at University level has been thirty-fold, i.e., an average rise of x2.2 per decade. This growth factor of x (2.0 ± 0.2) per ten years bears very good comparison with the average estimated economic (GNP) growth factor of x 1.9 per decade over the same span.

In the case of Japan [4], although schools on the European pattern were established from 1853 onwards, the reorganization of the whole education system was energetically taken in hand only after the Meiji Restoration of 1871. The Government methodically established model workshops, sent scientists and technicians on missions to foreign countries, spread knowledge through trade exhibitions, founded industrial R and D laboratories, granted financial aid, etc. The new system of education then introduced included six years elementary and five years grammar school, followed either by three years high school and three years at University or trade school of three years duration for studying technology, commerce, agriculture and forestry, or fishery management. In 1886, the School of Technology was attached to the Imperial

[4] U. Hashimoto, An historical synopsis of education and science in Japan from Meiji Restoration to the present day (1965).

Table 7: Comparison of expansion of education in the USSR, with the growth of GNP

Year	1914	1934	1954	1959	1964
Total enrollment	0.13 Million	0.4 Million	1.5 Million	2.1 Million	3.0 Million
Graduates	10,700	40,000	210,000	342,000	0.5 million
Institutions	105	250		766	(1,000)
Universities	8	-	-	40	-
Estimated GNP	$20 Billion	$50 Billion	$180 Billion	$280 Billion	$450 Billion

Table 8: Research institutes and scientific societies in Japan.

Period	Research Institutions		Scientific Societies	
	New	Total	New	Total
1868-1987	6	6	1	1
1878-1887	7	13	16	17
1888-1897	6	19	11	28
1898-1907	17	36	16	44
1908-1917	36	72	26	70
1918-1927	56	128	26	96

University; it was expanded to form the Institute of Technology in 1921. It was only natural that in addition to the universities, various scientific societies, academies, and research institutions should be established, and after 1914, it became clear that a systematic programme of scientific research was indispensable. In table 8 is shown the consequent steady growth of the number of research institutions and scientific societies during the six decades from 1868 to 1927. It is clear that during this period there was a more or less steady exponential growth in number of research institutes as well as scientific societies, the growth factor being 1.75 ± 0.05 per decade. This apparently laid the foundation for the phenomenal advancement of Japanese science and technology in the thirties. In 1925, the membership of these scientific societies numbered 122,000 of whom 50,000 were engineers. If we take account of the increasing size of each research institution or society, this actually corresponds to a growth factor of about 2.5 per decade in higher scientific effort, which may be compared with the decade growth rate of x1.8 in GNP, and with the factor of 2.2 per decade for total number of graduates in the USSR. Thus, in both countries, the growth rate of the economy is equal to that of engineers and technologists, who now make up 30 to 50% of the total highly trained manpower.

The expansion of technical training in China seems to have followed a similar pattern, and visitors have reported that, based on earlier technology transfer, China possessed about 50 specialized mono-functional research institutes in the mid-50s which paved the way for the high technology developed by China in the 60s.

In each of these three countries there was a massive technology transfer in the earlier stages. In the case of China, it was not well known and not often admitted, but the fact remains, that most of their heavy industry was developed by technology transfer, from Japan, the USA, and the USSR, about 30 years ago. Thereafter, the switch toward an appropriate technology type of structure took place, in which the emphasis was on the local people acquiring all the expertise and not only operating the machines themselves, but gradually learning to make and to improve those very machines which they were using. In the case of all three countries considered here, the complete cycle of educational growth, technological modernization and economic development appears to have taken 30 to 50 years.

A very important factor in the impact of higher technical education on industrialization and the transfer of technology is the relative proportion of trained graduates employed in industry and those in research. An analysis of this was made some years ago for the USA, Japan and several European countries, and the data (taken from the Economist of March 1968) are reproduced in Table 9. It can be seen that in the six countries studied, the number of graduates in industry per 1,000 of the total working population varies from 21 in Sweden to 75 in the U.S., and the number of researchers per 1,000 of total working

population varies from 8 for Japan to 29 in Sweden. The ratio of researchers to graduates in industry is an interesting criterion, and its values are given in Table 10. The values of this ratio in Table 10 are extremely revealing,

Table 9: Number of graduates in industry and researchers per 1000 of working population (1968).

Country	USA	JAPAN	CANADA	EEC	BRITAIN	SWEDEN
Graduates in industry per 1000	76	47	43	31	28	21
Researchers per 1000	24	8	20	27	28	29

Table 10: Ratio of researchers to science graduates in industry for some typical countries.

	USA	JAPAN	CANADA	EEC	BRITAIN	SWEDEN
Researchers: Graduates	1:3	1:6	1:2	1:1.2	1:1.0	1:0.7

Mean for three countries is 1:3.5

Mean for these countries is 1:1.0

because these show distinctly different patterns between the European countries with a 1:1 value for this ratio and the first three countries in the table, which have good technological utilization with values of this ratio ranging from 1:6 up to 1:2. It can be summed that a 1:3 relation of researchers to graduates is probably near the optimum for efficient industrial and technological advancement. Similarly, somewhere from two to four technicians are required per scientist in R and D institutions. Accordingly, it is perhaps equally important to give immediate attention to the proper training and selection of middle-level scientific and technical manpower, comprising the simple B.S. and the diploma-holding technicians who constitute the major proportion of the technical work force.

5. APPROPRIATE TECHNOLOGY

The large-scale capital intensive technologies developed in Europe, North America or Japan may well be very efficient, but their introduction into poorer, less developed societies often raises more problems than it can solve. A growing number of development experts and national policy makers are now beginning to question the wisdom of massive technology transfer from the industrialized countries to the developing nations. These require an education and industrial infrastructure which take decades to build up, the economic size of plants is usually too large for these countries' needs, and their disruptive social consequences (such as unemployment and rapid urbanization) tend to be much more sudden than in their culture of origin. But perhaps most important of all, their introduction often inhibits the growth of indigenous innovative capabilities, which are necessary if "development" is to take place.

The symbols of modernity, in the form of steel mills, chemical plants, automobile factories or squadrons of military aircraft can be purchased on the international market, but development is a complex social process, which rests, in large part, upon the internal innovative capabilities of a society. Imports of foreign ideas, values, and technologies have a major part to play, but few societies in history have developed exclusively on the basis of such imports. One of the major tasks facing the developing countries is to create, nurture, and more often than not rehabilitate their internal capacity to invent and innovate. As far as technology is concerned, this implies not only a much greater selectivity in the choice of imported equipment, plants, and methods of production, but also -- and this is much more important -- the invention and diffusion of new types of technology and new forms of organization *which are better suited to local conditions.*

The fact of the matter is that modernization of a society involves technological changes at many different levels, from large-scale steel mills and power stations to improved work methods on the farm or in the small town. Given rapid modernization as a desirable objective, the introduction of improved and appropriate technologies for higher productivity, increased use of local resources, and generation of employment may require a combination of the two above-mentioned extreme approaches, i.e., (a) the transfer of suitably selected existing technologies from elsewhere, with suitable adaptation and the training of people in their use and application, and (b) the development of new technologies with relevant infrastructures. In general, for most Asian countries, an appropriate technology can only be relevant if it can help to combat poverty, particularly in the more vulnerable segments of the society. At the same time it must take into account the local skills as well as the particular society's long-term development objectives and the different resources endowments that are specific to the country.

The course of development in many countries seems to have been an interesting mixture of high and low technology. For example, we note a side-by-side growth of sophisticated technology in China and in India along with the slow diffusion of the concepts of Appropriate Technology, based on the ideological statements by various Chinese and Indian leaders, some of them projecting simple living with high thinking and village-level traditional technology, while others have held that economic development depends on the growth of heavy industry.

Clearly, appropriate technology should aim at the optimal use of a nation's resources and assets. In many developing countries with an abundance of human skills and resources, this clearly means that it should be usually capital saving, labour-intensive, small- to medium-scale, and rural-based. But these conditions may not be applicable to other developing countries, where the labour situation is different and the industrial sector is significantly export-based. The example of Singapore is there clearly before us in which the export impetus has been largely responsible for the phenomenal development. In either case, whether one is manufacturing for indigenous consumption or for export, the appropriate technology should have the fundamental objective of promoting self-reliance in the people of the country. A people-oriented development programme requires an emphasis on economic growth as well as social justice, the two main features of what is now being termed the New International Economic Order. In the past, the emphasis has been almost entirely on economic growth, to the detriment of social justice. The creation of employment opportunities is one way of increasing minimum incomes while producing satisfactory growth, and carefully chosen technologies adapted to the labour and skill availability in most Asian countries can be an important means of effecting this.

In the past, great store has been set on transferring technologies that usually favoured highly capital-intensive and mass-production programmes, like steel production, which are doubtless desirable in their own context, but have a small direct employment potential. This concept needs in many cases to be replaced by one of *production by and for the people*, so that poverty can be removed through job-creation at comparatively low capital cost. This imposes a search for technologies of a medium level of sophistication, that will be more appropriate to the conditions and goals of the developing countries. In some sectors, it is quite possible that the appropriate technology may be the one which is the most sophisticated. The most quoted example is that of electronic assembly equipment for consumer products.

Among the desirable attributes that an appropriate technology should possess from the point of view of factor-endowment and the country's national development strategy, we may include the following:

(a) High employment potential.
(b) Low investment required, as compared to the level of local income.
(c) High potential in utilizing domestic material resources.

(d) Strong linkage with local industry to satisfy the actual needs of industrial clients and market.

(e) Higher productivity than existing traditional technology in the same field.

(f) Easy maintenance.

(g) Compatibility with prevailing sociological conditions in the locality.

If we concentrate in the first instance on the first three of the above basic national requirements, then it is possible to lay down some sort of quantitative criteria for "appropriateness", which may be considered under the heads of (i) labour intensiveness, (ii) small capital-cost per work-place, and (iii) import substitution, respectively. These three aspects have been looked at and frequently taken into consideration in the development of the country, and certain quantitative criteria have been suggested for differentiation between appropriateness and inappropriateness. Thus, for example: two parallel criteria for labour-intensiveness can be based [5] on the following two indices:

(i) Labour-intensiveness Factor = (No. of production workers in firms)/ firm's gross output),

and

(ii) 1 - Mechanization Factor = (No. of manual operations)/(Total No. of operations) in the particular manufacturing firm

1 - Mechanization Factor > 1/2 for labour-intensiveness

In case of labour-intensive industries, these two factors would have higher values than the national average and, of course, considerably higher than for the developed countries. Both these factors can provide guidelines for the policy-making bodies of developing countries. In addition to agriculture, typical industries that are labour-intensive may be quoted as footwear, small-scale food-processing, ready-made clothes manufacture, metalworking, and electric fan manufacture. Otherwise, nearly all our so-called "modernized" industry in Pakistan could be labelled inappropriate, according to the above two criteria.

The second characteristic, i.e., small capital-cost per work-place, in fact, requires that this cost be reasonable in comparison with the national per capita income; and the level of sophistication should be such that it matches with and encourages the spread of technical skills among the working population of the country. At present, the costs per work-place in the major industries in Pakistan range from Rs.20,000 to 300,000 (approximately) per work-place (Rs.10 ≅ $1); for example, in the modernized textile industry, a double-knitting economic unit requires Rs.70,000 per work-place, and a conventional spinning and weaving unit of 25,000 spindles and 500 looms nearly Rs.40,000 per work-place. The actual range will naturally vary from industry to industry, and the industry will be considered appropriate to the conditions in developing countries when the cost per work-place is low. The concept of appropriateness at the moment in Pakistan centres very largely around this matter of low capital-cost per work-place. In Pakistan, with our per capita GNP of about Rs.1,000, anything in the range Rs.2,000 to 10,000 per work-place can be a reasonable capital cost if the industry is to provide employment to people in the rural and small towns of the country, which is where the largest chunk of our working population comes from. Low capital cost per work-place is perhaps the most significant criterion for an appropriate technology which will be capable of absorbing the labor force available and through which the skills of the people can be appropriately developed so that they not only operate the machines but also manufacture and improve them.

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[5] "Indigenous Technology Indispensable for Self-Reliant Growth"--Report of National Seminar on Cooperation between (i) University (ii) Research Institute and (iii) Industry--F.C.C.I. Karachi 1977.

6. THE APPROPRIATE TECHNOLOGY DEVELOPMENT ORGANIZATION

In Pakistan, the Appropriate Technology Development Organization (ATDO) was set up about four years ago. The strengthening of the Appropriate Technology Development Organization was recommended in the draft proposals for Pakistan's Science Policy in 1976. The ATDO has already taken in hand the task of furthering several projects at the village level in the fields of food and agriculture, energy, small-scale industry, low-cost housing, agricultural implements, and new methods of irrigation for arid regions. A considerable measure of success has been obtained in several projects, notably:

1. Low-cost pre-fabricated urban housing and rural schools.
2. Biogas plants for producing gas and fertilizer from wastes.
3. Small hydro-electric units for local fabrication in far-flung areas.
4. Dehydration of vegetables and fruits.
5. Production of hand-made matches.
6. "Nay-Fishar" screw-type cane-juice extractor for use at the village level.

For these activities, the ATDO of course utilizes the trained manpower and facilities already existing in the Universities, the Research Institutes, and private industry within the country. In some ways, the function of ATDO can be compared with that of a catalyst, to motivate these people to do the design and development work, while we carry out the extension activities.

Recently, a project has also been started by ATDO under the heading of Village-Level Food Processing, which seeks to identify, develop, produce, and ultimately disseminate (on a pilot-project basis) improved appropriate technology of a suitable scale and sophistication for use in farm and village-level processing of sugar cane, oilseeds, and rice bran. The project is based on the premise that elements of more efficient technology exist elsewhere in the world, can be identified and brought to Pakistan, where modifications and adaptations can be undertaken as required to permit local fabrication and commercially viable operation in the village environment. The project is being carried out in four carefully overlapping phases, of which the first two have now been completed. Denver Research Institute, the Pakistan Council for Scientific and Industrial Research (PCSIR), and other Pakistani organizations are involved in the execution. It is hoped that successful completion of this project will enable a substantial increase in the yields of sugar and oil at the village level, and also increase employment opportunities.

Sugar cane processing presents a very interesting picture, to which some reference was made yesterday, by one of the speakers from the Caribbean, namely, that the cost of production of sugar in the sophisticated mill is, today, higher than the international price of sugar. Now, the village level technology, which is supposed to be inefficient, is supposed to have losses at various stages, and is crude in every way -- strangely enough, comes up with precisely the same cost of production as the large mill. We are still in the process of trying to analyze what is the reason for this, because the large-scale technology is supposed to be much more efficient. I have a strong suspicion that one of the basic reasons is that the capital costs for the large mill are high. Because money also has a cost, namely the rate of interest that you pay on it per annum, the price of the product goes up automatically by 15%, or whatever it is, in the large mills, which almost entirely offsets their technical advantages.

Now this is something very important and very significant. And we are having a very hard time convincing people at home that this is so. Because, somehow we have an in-built mechanism whereby we feel that the large mill must be more efficient, must be better, and the product coming out from the large factory must be intrinsically superior to everything that we could do in a smaller unit. Now that is not necessarily so. Every process needs to be examined, in its own right.

This example brings out the point that I wish to stress, that in transferring any technology, it is important that within each developing country, there should be a mechanism available for assessing the

applicability of that particular technology within that country, and comparing it with all the other technologies that are available. Now certain suggestions have been put forward of having an international registry of technology, but that does not solve the problem. Ultimately, an assessment has to be made within that particular country of how the various technologies, if they are transferred, would compare with each other, and for this, some sort of a capability to make the analysis needs to be built up within each of the developing countries.

The third characteristic, namely high potential for utilizing domestic material resources, has usually been given a good deal of attention practically from the inception of Pakistan, but considerable exceptions have been made in the case of high-technology industries like electric machinery, electronics, plastics, fertilizers. In our country, the Pakistan Council of Scientific and Industrial Research, like the corresponding institutes in various other developing countries, has been working at it. But here, the big problem arises, the products of the research are not readily accepted by the industry. The emphasis having been on "turnkey" jobs in the earlier years of Pakistan, there has been a distinct reluctance on the part of industrialists to make proper use of the indigenously developed technological capabilities. The industrialist seems to have ingrained suspicion of anything that is home-grown or home-developed. Perhaps he is not sure that it will work at a profit. He has been taught and told that that which comes from abroad is well-tried and well-tested. But the fact remains that that was well-tried and well-tested maybe 20 years ago, and the conditions today are not what they were 20 years ago. It may operate under these conditions, or it may not. So, here we have a problem.

It is also true that, while there is considerable R and D talent in the country, as also a realization of the importance of developing indigenous technology, certain weaknesses are noticeable in the existing framework of quality-control in industry (especially of the small- and medium-scale), in R and D, and in the adaptation and extension of technology, all of which are required to be made up urgently. For instance, without adequate quality control, it is hardly possible to develop any sort of indigenous technology to a competitive level. This is, moreover, a first step to improved methods and processes.

In an effort to attack these problems, a National Seminar on Cooperation between Universities, Industry, and Research Institutes was organized at Karachi in 1977 by the Federation of Pakistan Chambers of Commerce and Industry [5]. Among the recommendations emerging from this, the following are noteworthy:

(a) There should be exchange of personnel between university, research institute and industry at the advisory and management level. Also, (i) university, and (ii) research institute should exchange with each other workers; and (iii) industry should be brought within the purview of such arrangement. (This is something which is fairly well known in the USA but which does not seem to be so common in the developing countries.)

(b) Government should take measures to inventory the work done so far in research institutes and the processes and products which are being utilized or are suitable for utilization in industry.

(c) A Research Utilization Board should be set up within the Federation of Pakistan Chambers of Commerce and Industry (FPCCI) on a permanent basis, having representatives from research institutes (including consultant firms and companies) and universities. The proposed Board should be adequately financed.

(d) Large industrial concerns should have 'innovation cells' within their premises and guide and advise the (i) university and (ii) research institutes in respect of their needs and requirements so that university and research institute can orient their research programmes accordingly.

(e) Fuller recognition should be given to the talented pool of innovation and adaption available in the skilled groups of technicians (such as those called "MISTRIES" in Pakistan) and their status be up-graded.

(f) Associations of medium and small industries should jointly set up laboratories and research centres within their premises to render research service to those industries. These laboratories and research centres should also accept students from universities as trainees.

(g) In-plant training facilities should be expanded, and it should be made a condition precedent for the award of degree in science, engineering, and business administration, that a student has received in-plant training in industry.

Item (e) above comes back to a philosophical problem, or the problem of attitude. The man who has the expertise is quite often looked upon with suspicion. It is true, knowledge combined with expertise is the best thing, but, if I were told that I could have only one, I am sure I would go for the expertise and leave the knowledge alone. Because knowledge without technology is useless, it is the expertise that is essential. The man who is able to make the engine work, the man who is able to repair the instrument, is very much more valuable in any organization than those who have merely abstract knowledge.

I remember when I was in charge of the Physics Division of the PCSIR, we had an instrument maker who was very deft, very clever with his hands. He could repair an instrument, he could make an instrument that you designed for him. But he was a cantankerous old man. He was bad-tempered, he was rude to nearly all the research staff on occasions, and they came to me in a delegation, asking that we should get rid of that instrument maker. Well, I explained to them that he was a very useful person, that we cannot, it was absolutely impossible. So I proposed the alternative, I said, "Well, would you please take upon yourselves the responsibility of repairing all the instruments in the Physics Laboratory? I will sack him immediately." They all went away, without any further comment.

I think we do need to develop and appreciate the large pool of technical expertise that is available in our countries. We are losing that, because we are consciously drifting away from those industries which have a strong indigenous base, whereas if we wish really to have a biologically growing process of technological development, then it is this very base which we should tap, and we should graft onto the base. This is something which I think seems to have been taken care of in countries like Singapore, where they have one Polytechnic which turns out 1000 diploma holders. Now I hope, and I trust, that their diploma holders do not wish to become white collar engineers, because we have had that experience in our country. The diploma holders from several of the Polytechnics did agitate to be granted engineering degrees, at one time, which of course would defeat the very purpose of the idea of a Polytechnic.

7. CONCLUSION

It needs to be emphasized that for a developing country to emerge from the state of under-developedness and forge ahead of others, it is necessary for it progressively to develop a body of highly-motivated technologists, scientists, and technicians, possessing a belief in their own destiny. Such a group can be developed only by motivation provided through basic moral and ethical values. This may be taken as a fundamental law based on the history of nations, at least over the last 2,000 years.

What science can contribute at least to the developing countries is its methodology, because that is something that can be applied to many problems. The trained mind is an asset, however it is applied, but we should not blindly support open-ended pure research. There appears to be a lack of people who are

able to bridge the gap between research and applications. Partly because "the typical scientist from the third world has had a very sheltered education -- boarding school, residential university, foreign university and straight back into a university or research institute -- he often wants to do the research he learnt in the West because he knows no alternative." If we support him in this instead of, say, helping him win a development research contract, we are doing a disservice. Meanwhile, many companies have to hire expatriate production managers because they cannot find suitable local people. With more appropriate teaching and motivation, our graduates could surely contribute much more to the production, if not the distribution, of wealth -- it is after all lack of these that make a developing country poor.

The West needs research on which to build its high technology; but most of the technology the developing world wants already exists, and the immediate need is to learn to select, adapt, and use it. One could suggest at least two general principles to apply to science proposals: (i) clear objectives must be spelt out, agreed and followed; (ii) projects should be primarily assessed on a strictly utilitarian basis, with a view to the widest spread of their benefits.

In fact, what we want is an optimum mix of the so-called "intermediate" technology and high technology at any given time, and this is where the developed nations can help the developing ones, in three different directions, with which I will conclude:

First, to induce, as I said before, the setting up of national centres for technology transfer and providing appropriate training, for building up a decision making capability with regard to the technology transfer, within the developing countries.

Secondly, to encourage local R, D and E for projects in the developing countries. In other words, those multinational corporations which have projects in developing countries, should be motivated to provide local development and extension cells within the developing countries, rather than go back for this to the parent country. This is one way in which the local infrastructure can be strengthened, quickly, and this would in the long run feed back benefits to both sides.

And, finally, consider putting the brain drain in reverse, by putting a sizable effort in the developing countries, on projects that have immediate relevance to those countries. At the moment, the situation is the reverse. Our scientists working in the developed countries usually work on projects which have nothing whatever to do with our problems.

APPENDIX A

DERIVATION OF TECHNOLOGICAL CAPABILITY AND TRANSFER INDICES

In a recent paper on technology transfer, the author [6] described the formulation of a Technical Development Capability Index,

$$(\text{GNP})^{0.55} \times (\text{per capital GNP})^{0.45} \quad (1)$$

which can be used to predict the type of projects most suitable for effective technology transfer at a given time in a country.

The experience of the last 50 years in various attempts of technology transfer leads to several general conclusions, some of which can now be put down as basic Principles of Technology Transfer. First and foremost, the amount of Technology Transfer, both qualitatively and quantitatively, depends on the capabilities of the recipient country as well as the donor country. The quantity may reasonably be considered as related to the GNP, while the quality can be measured by the per capita GNP, and the combination is then found to lead to the Development Capability Index derived above. Technology Transfer can be taken as being proportional to the function,

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[6] M. M. Qurashi, Proc. Pak. Acad. Sci. 13, 55 (1976).

$$\left[\text{Development Capability of recipient} \times \frac{(\text{Dev.Capability of Donor})^{m}}{(\text{Dev.Capability of Recipient})^{m}}\right]^{p} \quad (2)$$

where the power $p \cong 2$ and 'm' should be between the limits of 0 and 1, because if $m = 1$, then the transfer depends solely on the donor's development capability, while $m = 0$ implies that the donor capability has no influence at all. We may, as a first approximation take 'm' to be in the middle of this range, i.e., $m = 1/2$ and so write

$$\text{Optimal Technology Transfer} \approx \left[(\text{Dev.capability of recipient}) \times \frac{(\text{Dev.Cap. of donor})^{1/2}}{(\text{Dev.Cap. of Recipient})^{1/2}}\right]^{2}$$

$$= (\text{Dev.Capability of recipient}) \times (\text{Dev.Capability of donor}) \quad (3)$$

$$= \left\{ (\text{GNP})_{\text{mean}}^{0.55} \times (\text{per cap. GNP})_{\text{mean}}^{0.45} \right\}^{2} \quad (4)$$

which may be called the Technology Transfer Function, where $(\text{GNP})_{\text{Mean}}$ is the Geometric Mean of GNP and per cap.$(\text{GNP})_{\text{Mean}}$ is the Geometric Mean of per cap.GNP for donor and recipient. When the two are close together, the geometric mean can be replaced to a good approximation by the arithmetic mean; in such cases, there may also be considerable reverse transfer of technology.

An experimental verification of the above theoretical derivation can be found in figure 2, in which the amount of foreign exchange spent annually on the import of unembodied technology [7] (i.e., patents, know-how and technical services) by 19 developing countries around 1965-70 are plotted logarithmically against the Technology Transfer Function. The plotted points split up into two lots, through each of which a mean straight line can be drawn, the upper one with slope = 1.0 for eleven countries, and lower one with slope = 2.0, the two meeting somewhere near a Developmen Index of about $55 million. The upper one is mostly for countries with per capita GNP < 450, with Pakistan, Mexico, and Nigeri as unusually high spenders, and fits the equation 3, yielding the result

Expend. on unembodied Tech. Transfer

= 12 x (Recipient Dev. Index)

= 0.21 x (Tech. Transfer Function) (5)

One can further deduce from the estimates ir the UNCTAD reports that the unembodied technology accounts for 1/10 to 1/3 of the total spent on technology transfer. The lower graph in the figure corresponds to a certain group of countries that includes oil-producers, like Iran and Venezuela, and countries with other special resources. Its slope shows that these countries, which are relatively late starters in technology transfer, are nevertheless catching up fast by more-steeply rising inputs, as indicated by the equation to the lower graph viz.

Expend. on Unembodied Technology

= 0.25 x (Recipient Develop Index/60) x (Technology Transfer Function)

= 0.25 x (Recipient Dev. Index)^2 (6)

Both the empirical equations (5) and (6) are particular cases of the technology transfer equation (2), corresponding to the case of $m = 1/2$ and $m = 1$. Thus equation (2) is the quantitative First Principle of Technology Transfer. In fact, it can be generally seen that the slope of the upper line in the Figure equals m x p, while that of the second one would be equal to p, thus giving

$$m \times p = 1.00 \quad \text{and} \quad p = 2.0$$

whence it follows that

$$m = \frac{mp}{p} = \frac{1.00}{2.0} = 0.50$$

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[7] UNCTAD document, TD/E/AC. 11/10, dt. 13-12-72.

This gives us an empirical determination of m as being equal to 1/2.

DISCUSSION:

Dr. Somer (Turkey):

I enjoyed very much hearing the paper presented by Dr. Qurashi. I am quite familiar with the conditions in Pakistan, because Pakistan, Turkey, and Iran are joined in RCD projects, within the CENTO organization. Many of the problems he so very nicely formulated are common in that area, particularly in Turkey and Iran.

For instance, he complained about the products of research not being readily accepted. This is a common problem. I remember one case, when a certain problem was contracted to a German firm, and the German firm in turn subcontracted to a Turkish firm to do the same job. In other words, this inferiority complex in developing countries does exist, and it is costly. They seldom have confidence in the suggestions of their own people or in the projects prepared by them. They have to be certified or they have to be prepared by agencies outside the country. This is very costly, and I hope that someday this is somehow reversed.

Another point he brought out was the necessity for education of scientists, technologists, and technicians before development can be expected in a country. I fully agree with him.

But, the brain drain that he touched upon is another matter. He may be surprised to hear that I broached this question with some of the leaders in Pakistan, and asked them their opinion what to do about it, because we had the same problem. Today, many of the Turkish scientists, Pakistani scientists, engineers, doctors, work in countries outside of their own. For instance, I have met many engineers from Pakistan working in Saudi Arabia, in Europe, in the United States, in England. But I was surprised to hear that some of the officials in Pakistan somehow favored this. In other words, they were not as sorry as I was, that brain drain was causing damage to the country. In a way, they couldn't provide jobs for them; they were dissatisfied. It would be better for these engineers to go out, earn some money, and probably come back later on. I would ask Dr. Qurashi to comment on this, and to correct me if I am wrong. Because brain drain is definitely a problem that prevents rapid development of a country. After all, training of a good engineer takes at least 15-18 years, and one cannot afford to lose them after they are trained and ready to serve their own country.

Dr. Qurashi mentioned a number of areas in which Pakistan has made great progress -- in sugar manufacture, in textiles, and others. He did not mention the nuclear field. I can proudly say that in that area, in nuclear technology, Pakistan has done a great job. In fact, he is the leader in that area, in nuclear power generation.

With respect to the jute that he mentioned, which is a product of the eastern part, now Bangladesh, plastics are being substituted to a large extent, in place of jute, and Bangladesh is in serious trouble because they cannot enjoy the same market that they used to have. It is one good example where research is definitely needed, for new products, and not to rely on the old ones.

Miss Armstrong (New York City):

Dr. Qurashi suggested that there may be room for what I will call multiple technologies, i.e., the small sugar producers can produce, and the large-scale can operate. Often, the bureaucratic tendency is to say, choose one or the other. If you have multiple technologies, as indeed Japan developed with, for example, then you often have to have different regulations for different sizes of enterprises -- different tax systems, different standards for different kinds of enterprises, physical standards, health standards, and so forth. I am really wondering whether within your government machinery you find this practicable? It may be practical for economic growth. Can your bureaucracy stand it?

Dr. Qurashi:

This is certainly something that is of great significance, and it does need to be done.

Because whenever one is examining as to which is the best technology, one usually does not have one choice that sticks out head and ears over the others. Usually there are two or three competing ones, and the conditions which will make one more profitable as against the other, may be reversed in five or ten years. And therefore one does want to allow the alternatives to at least exist. One does not want to stamp them out completely, otherwise they will not be available when you need them. Now, in the bureaucratic system, while they do try to oversimplify and like to have just one answer -- yes or no -- to everything, I think they are now gradually being educated into this process. Again, I must say that the U.S. and the U.K. have been responsible for this education, through the Intermediate Technology Group of England, and the present emphasis in the United Nations on Appropriate Technology. And I think this can be brought about through appropriate recommendations.

Miss Armstrong (written commentary notes):

Technology is a means to an end, not an end in itself. It is "good" when it serves the objectives of "management" (which can be government, company, an entrepreneur, etc., or any combinations of these). Integration into a working system is required.

Who is choosing the objectives (de factor or de jure)? Are techniques chosen which best serve the objectives of society or a particular enterprise? Or are technologies chosen because they are available or "good" elsewhere? If so, do they thereby impose objectives on the recipient society (or fail because they are not suitable)?

Some of the measures often usable in developing countries are:

(a) Increased number of people engaged in productive activity (through employment, or as suppliers or servicers to industry).

(b) Low investment in relation to return.

(c) Effect on foreign exchange.

(d) Use of local material resources.

(e) Linkages with other local enterprises.

(f) Production cost versus import cost.

(g) Regional development and other sociological effects.

The term "transfer" is a misnomer. Technology works only if developed in relation to the local situation. "Transfer" does not work. There are endless examples of local people learning to make a project work, but not knowing how to make further adaptive changes.

The latest is not necessarily the best. Nor is "catching up". "Best" is what suits your purposes. Competitive products can often be produced with "older" technologies.

How can the U.S. be more constructive?

Support more R and D about, in, and with developing countries -- for both U.S. and non-U.S. citizens.

Fellowships to train U.S. and foreign citizens in developing countries or to undertake research on developing country technologies.

Other?

PAPER 6.3 - MANAGEMENT PRINCIPLES IN INDUSTRIALIZATION

Dr. James A. Slater
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You have heard my main thesis before during this seminar, but I think it really bears repeating because of its great importance in industrialization. My thesis is that knowledge and application of sound management principles is really the basis of, and is a firm requirement for, industrializing countries. Technicians and administrators must be able to plan, organize, direct, staff, and control their operations.

Poor management is probably the greatest single problem in industrial development. Unfortunately, it is a difficult problem to correct. Nobody likes to hear about, and nobody will admit to, being a poor manager. Personnel attitudes in an organization are very negative toward management changes. Few managers know the principles of management, and probably fewer yet apply them when they know them.

Let's look at some typical management shortcomings, based upon my limited experience in dealing with both the developing and the developed nations. Under the organic functions of management, let's start with planning.

Development is often not based on needs. I think it is a very basic fundamental of good operations -- business or government -- to determine first what are the needs of the operations, and industrialization operations must be based around those needs.

I remember doing work in Nigeria and looking at a $100,000 retail market, that was funded by AID. A beautiful place -- it was all self-enclosed and had fine artistry on the walls -- and it cost $100,000. It was really comical that the retailers were setting up their orange crates and boxes around the outside of the market place, not in the building itself. It wasn't based on their needs. I think a $10,000 market would have been quite sufficient. What the retailers needed was a roof over their heads, a place to weigh their merchandise, water, and so forth, and those were the basics.

This reminds me of the story of the sales manager who was before his salesmen, indicating what a great product the company had. They had the finest dog food on the market. It had the highest vitamin content, protein, low fat, everything that a dog could want. And he asked a salesman, "What's wrong, why aren't you selling this marvelous product?" And the fellow shot back, "Because the dogs won't eat the darn stuff." They were not looking at the basic needs and desires of the consuming market.

Under the function of organizing, I think we see in many industrializing situations a lack of communications. It is a very easy problem to get at, if we simply hold meetings, discuss with our colleagues what we are doing, use the telephone, send drop copies of correspondence, and the like. I think that through contacts with the field and central offices, we can get at this problem of basic communications.

I have seen, and you have seen I am sure, managerial situations where we have an indefinite chain of command. A worker doesn't know who his boss is. Or he may have more than one boss. This is a very clear violation of management principles. We must have that focal point in the organization. It is a very basic theorem of management that if you cannot diagram an organization, it is *prima facie* evidence that there is poor organization in that operation.

Under the principle of staffing, we many times find that there is a lack of institution building in industrializing countries. The solution to this problem is that we must provide counterpart training.

I was recently in a developing country, and one of our experts there had offered to take out the counterpart trainees many, many times on field research. He was a world-renowned expert in his field of research. And one time, he got one of the counterparts to go along with him. On the basis not that he would be with the U.S. expert at 6 o'clock in

the morning to start a two week field trip, but the counterpart rather would fly up to the place where the work was to be done. He would meet the U.S. expert up there at a reasonable hour, like one or two o'clock in the afternoon, he would spend a couple hours in the field with him, he would fly back that same day, while our expert would go on and conduct the rest of his two weeks of research in the field. It is very difficult to get some of these people out in the field where they can get that training that is so necessary.

Under the function of direction, I think we find that in many industrializing situations, there is a different emphasis or a different weighting on the economic constraints. Time, cost, quality, and quantity in developing country situations have different weights than what we apply in this country. For example, in some of the work we are doing in Saudi Arabia, time and quantity rank very high in the economic constraints, whereas quality and cost require less weighting. We must have very clear direction in carrying on an operation.

Lastly, under the organic function of control, I think we've seen in our work abroad situations where many of the executives have too broad a span of executive control. I recently had discussions with a deputy minister in a developing country, and his span of executive control reached to the point of giving authority to duplicate work on a duplicating machine. He interrupted our interview for a minute or two to look at a requisition to make 20 copies of an engineering drawing. Now I would say that that is reaching out in the span of executive control and certainly hindered the industrialization of that country.

Lack of personal incentives: we've seen this a great deal, both the non-monetary incentives and monetary incentives. You are all familiar with the Hawthorne studies, and what they produced in terms of the non-monetary incentives. People need a challenging job, a job that is interesting, a job where they know that management cares, in its operations and its treatment of the workers. This is vital, as are the monetary incentives. So that is, I think, a very important factor in industrialization.

I've only hit upon some of the principles of management that are being violated. I think that this whole area of management is critical in industrializing. We must continue to pay attention to it, and I think through proper application of management principles, a lot of the work will progress much faster.

SECTION 7 - KNOWLEDGE REQUIRED TO ENABLE A COUNTRY TO ACQUIRE COMMERCIAL INDUSTRIAL TECHNOLOGY

Chairman: Albert R. Baron, Interregional Adviser, Development Planning Department of Technical Cooperation for Development, United Nations, New York City.

CHAIRMAN'S COMMENTS:

Mr. Issoufou S. Djermakoye, Under-Secretary-General in charge of the Department of Technical Cooperation for Development of the United Nations, is unable to be present to chair this session as planned, due to late-rising and urgent requirements for his presence at the United Nations. As a result, I am fortunate to have the opportunity to chair this session. Mr. Djermakoye's prepared remarks will appear in the published Proceedings. What I would like to do now is to make a few personal remarks which are inspired by the exchanges this morning and yesterday afternoon.

First of all, I think the Bureau of Standards has done a particular service in focussing this Seminar on the *industrial* aspects of development, the technological basis for industry. Now, of course, the UN Conference on Science and Technology for Development, in Vienna next year, is going to cover all aspects of development, from environment to energy to rural development, agriculture, etc., including industry. The point I would make here, is that in recent years, U.S. technical assistance, U.S. AID, has, by design, been very heavily focussed on the problems of poverty, of rural uplift, of food production, of agricultural production, very important problems, and the major emphasis, at least in the public programs, has been directed, and I believe rightly so, to non-industrial development, *per se*. But, and this I think is the point, the United States with its tremendous reservoir of know-how in what is called in this session, commercial industrial technology, this tremendous know-how is here, but is not really being made as available as it might be, to the developing world. I think that that is something that many people in the United States understand, and one of the purposes of this Seminar is to focus on ways and mechanisms to increase the flow of assistance from the United States in this area of the technological base for industrialization.

I would also like to add that in considering how to stimulate the flow of transfer or adaptation of technology, one should not only consider what the public sector can do, but, as many other speakers have already mentioned, also the private sector contributions. Mechanisms for utilizing the private sector must be looked at.

I would like to mention three aspects of industrialization which I think need to be borne in mind:

The first is the imperative of sound planning, national planning, sectorial planning, and project design. Too many industrial projects in too many countries failed because the basic project design work was improperly or inadequately done. The financial or technical or social analyses just were not adequate. So I do feel that the importance of tapping technological know-how at the project design level can scarcely be over-emphasized, and what clearly needs to be done over the years in many, many countries, is to increase the country's capability to manage project design well.

Second, I would like to recall that in many countries today, the concern is not only the establishment of new industry, but also, a real concern about how to get their existing industrial plant working effectively. One can go around the continents and point out many, many countries where a good proportion of industrial plant is not working properly or is subsidized at a heavy cost. What is needed is better management and improved technological developments in those failing industries.

The third point that I would like to make is that there is a special need in nearly all countries to look at the requirements for promotion of small or medium-sized business, which is a special problem.

PAPER 7.1 - REMARKS PREPARED FOR THE NBS/AID UNCSTD SEMINAR: THE TECHNOLOGICAL BASE FOR INDUSTRIALIZING COUNTRIES

Issoufou S. Djermakoye
Undersecretary-General
Department of Technical Cooperation for Development
United Nations, New York

Mr. Chairman, Ladies, Gentlemen, Distinguished Panelists-

I consider it a privilege to be in Washington, D.C., capital of the United States of America, and I would like to take this opportunity to greet, on behalf of the United Nations and particularly on behalf of the Third World, the American people, their President Mr. Jimmy Carter, their Government, and members of the Congress. Greetings and thanks also to the distinguished organizers and participants of this Conference.

The annual general meeting of the International Monetary Fund and of the World Bank, which was held from 24 to 28 September here in Washington, gathered financial and planning ministers and investment organizations responsible for world monetary, economic, and financial destinies and for balanced relations between the northern and southern hemispheres. I listened with interest to the various speeches, and along with the other participants, I appreciated the scope of President Carter's impressive speech and his tireless contribution, so necessary to safeguard what our modern world needs most, namely peace.

During the IMF and IBRD meetings, I was once more struck by the interdependence of the economies of the international human community and by the interaction of all the basic prerequisites to the establishment of a new world economic order, most just and more humane. The purpose of our meeting here will be to examine the basis of one of these prerequisites, namely the transfer of technology.

However, I must also point to progress made in an area which has resulted in a chain reaction of other initiatives. I am referring to the implementation, in fact and in reality, of the 1970 United Nations General Assembly resolution. This resolution set at 0.7% of the gross national product the minimum amount of aid from the industrialized countries to the Third World.

Since 1970, the amount of this aid never rose above one half of this percentage. In fact, a regular decrease has been registered, since in 1976 and 1977, the absolute total of this aid was lower in real terms than it was in 1971, 1972, and 1973.

The Third World countries paid tribute to the Netherlands, Norway and Sweden, which went over the 0.7% aid figure. At the same time, they will continue to express their confidence that gradually the industrialized countries as a whole will do their utmost in the next decade to also reach, if not surpass, this minimum set by the United Nations, knowing that a better balance for the world is at stake, sole guarantor of a real peace and better global security.

With reference to the problem mentioned earlier of basic prerequisites, we must continue to bear in mind the justified and repeated concerns of the Third World during the work of the Second Committee of the General Assembly of the United Nations, and at UNCTAD, concerning a realistic approach to the transfer of technology, including the need to lead to a revision of the 1883 Paris Agreement on Industrial Property, and establishment of a code of international conduct with regard to the transfer of technology.

Let us now take up the basic theme of the seminar: "The technological knowledge base for industrializing countries".

First, I note that the organizers of the conference have carefully arranged the various panel sessions to help define more clearly the needs of developing nations for knowledge of the technologies for industrialization.

Secondly, the various sessions will make it possible to explore procedures which have proven effective in developing countries in acquiring technical knowledge and in adapting it to local needs. The presence of so many distinguished representatives from developing countries, from U.S. industry and from U.S. institutions concerned with science and technology and industrialization certainly holds promise that the outcome of these two days will be to illuminate specific steps to accelerate technological development in the Third World.

I also note that the seminar has been organized with the sponsorship of the Department of State, the Agency of International Development, the Department of Commerce, and the prestigious U.S. National Bureau of Standards in order to contribute to preparations for the United Nations Conference on Science and Technology for Development to be held in Vienna next August, by considering in particular the transfer and adaptation of technical knowledge for industrialization. The UNCSTD will of course deal with the need to expand the technology base for all aspects of development. I have been pleased to note the emphasis of this seminar on the industrialization aspect, because it does appear evident that much more can be done by the United States to facilitate tapping by the Third World of the vast technological know-how of America in the field of industry. I hope, therefore, that this seminar will lead to concrete recommendations for developing public and private mechanisms to augment the flow of U.S. industrial technological know-how to the developing countries.

Another essential point is that we are gathered here not only to try and solve all kinds of problems which still act as blocks to comprehensive development efforts, but first and foremost to find arrangements and solutions which will respond to the search of the peoples of the Third World for a nourishing and need-satisfying culture. We must devote ourselves to discover and create that which is basic to their priorities and to the multiple requirements of a new international economic order for a fair redistribution of our planet's resources and better international justice. We need, in short, to help the Third World introduce and adapt technologies (industrial and others) which are people-oriented, which develop self-reliance and which foster the new international economic order.

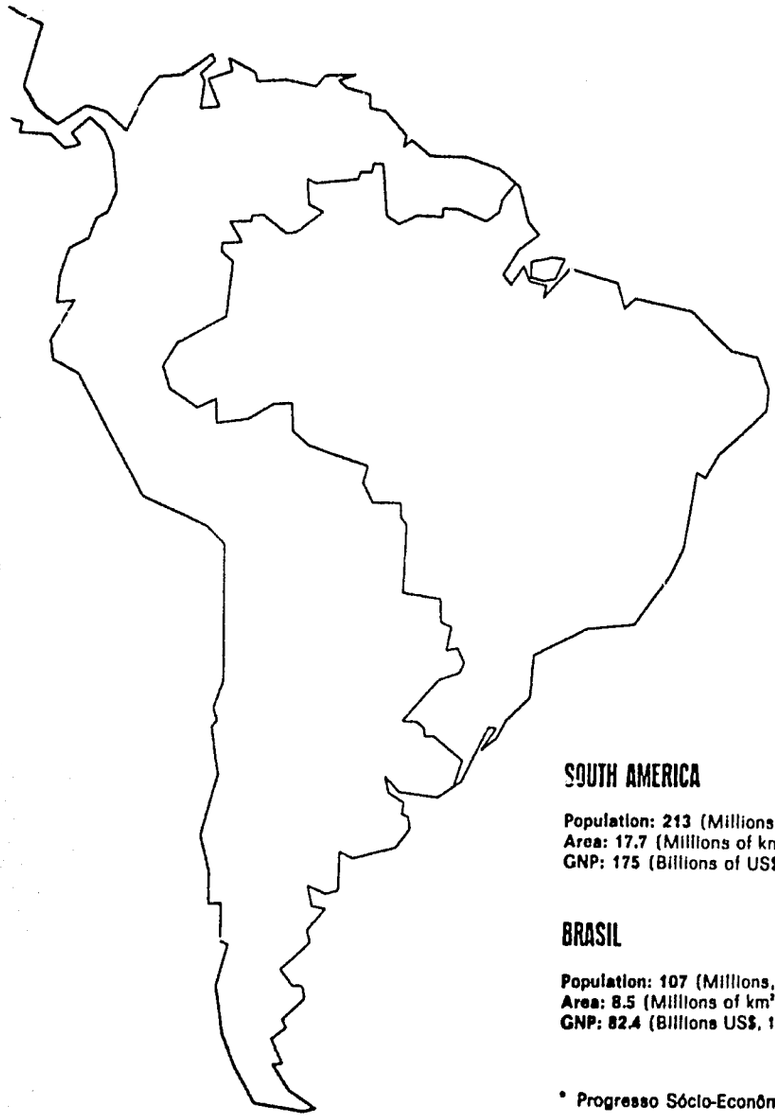
I have not wanted to take up too much of the panel's limited time with my remarks, and have endeavored to keep them brief. I would like to conclude by underlining for the attention of all thinking men, professors, researchers, technicians, experts in science and technology the extent to which developing countries and especially the poorest ones, place their hope and trust in their total cooperation in the struggle for freedom, dignity, life, and for the know-how to fight against hunger, illiteracy, poverty, joblessness, sickness, and death. The men, women, and children of the Third World know that the people of the United States will, along with other industrialized nations, make their exceptional scientific and technological capital available to the developing nations.

In the words of Mr. Kurt Waldheim, Secretary General of the United Nations, at the recent meeting of the International Chamber of Commerce in Orlando Florida on October 1st:

"Let us not lose sight of the fact that, for the first time in history, we have at our means the resources and ability to bring about a better life *for all peoples*. We do not have much time. The new decade is almost upon us, and the new century is not far away. We must, in these few years, make meaningful progress in solving our burning economic problems. We can only do this if we are committed to the advancement of human welfare and human dignity. This, in my view, is a great challenge of our time. Let us determine to meet it with imagination and courage in order to build a better life for all".

Ladies and Gentlemen, I thank you.

FIG. 2.1



SOUTH AMERICA

Population: 213 (Millions, 1975) *
Area: 17.7 (Millions of km²)
GNP: 175 (Billions of US$, 1975) *

BRASIL

Population: 107 (Millions, 1975) *
Area: 8.5 (Millions of km²)
GNP: 82.4 (Billions US$, 1975) *

* Progresso Sócio-Econômico na América Latina, Interamerican Development Bank.

PAPER 7.2 - KNOWLEDGE REQUIRED TO ENABLE A COUNTRY TO ACQUIRE COMMERCIAL INDUSTRIAL TECHNOLOGY -- EXPERIENCE OF A COUNTRY WITH AN INTERMEDIATE ECONOMY

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1. INTRODUCTION AND SUMMARY

I will speak about some experiences in acquiring technology in the region of Sao Paulo. First of all, I like the idea of speaking of *acquiring* technology, as contrasted to the common expression, *transfer* of technology. I believe that "acquiring" is an active act. You have to be active if you want to find some technology in this world. I will try to make a rapid summary of the conditions in the country, and then try to make some points that I think should be discussed.

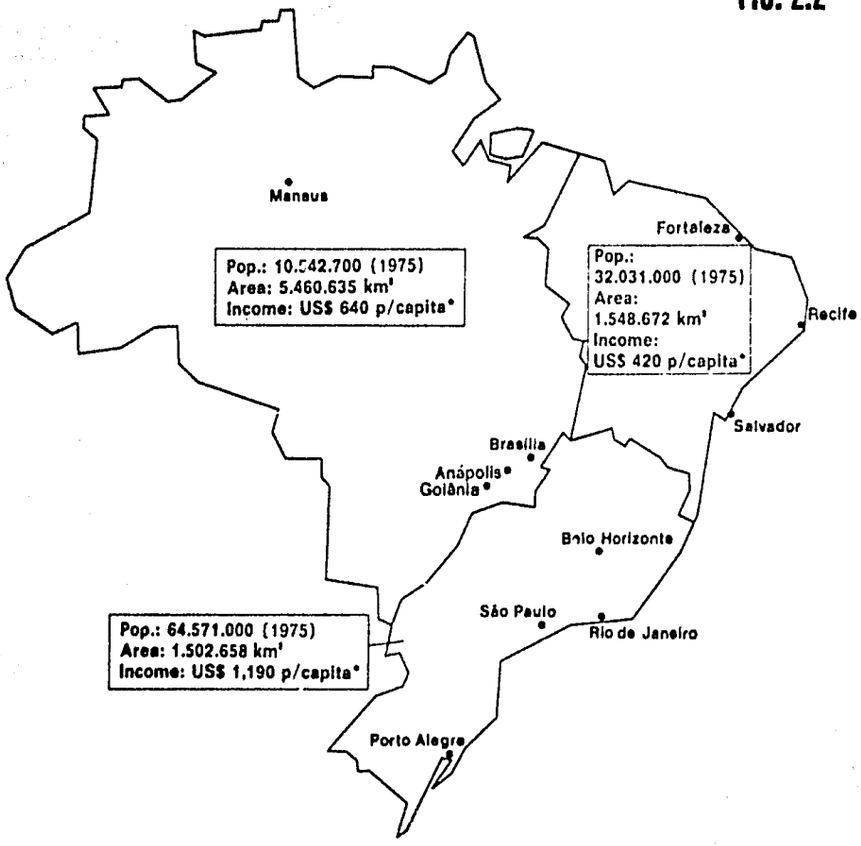
After a long historical period of a slow maturation, the Brazilian manufacturing industry started to grow during the 30s and has been keeping a rather steady pace of growth since the mid-40s in spite of some intervening slumps. This growth started with the development of some manufacturing industries by Brazilian entrepreneurs, mainly in the urban areas of Sao Paulo, Rio de Janeiro, Minas Gerais and Rio Grande do Sul, the first one being the most important. Foreign and multinational companies joined this development later, in the same urban areas, constituting a second segment of the Brazilian manufacturing industry. A third segment is constituted by state-owned enterprises, mainly in the steel and petroleum industries; the state-owned enterprises also have had a very important participation in the development of basic industrial services, such as electric power, railroads, navigation, and communications. Joint ventures, represented by industrial manufacturing companies with a participation of both Brazilian private and foreign interests, have not been uncommon and, very recently, a new kind of a hybrid has appeared in the form of several joint ventures with a tripartite participation of state-owned companies, Brazilian private interests, and foreign or multinational companies.

The characteristics of the modes of acquiring the necessary technology have a very important bearing on the distribution of the different industrial initiatives among the various above segments. The present paper deals mainly with the acquisition of technology by the first segment of the Brazilian manufacturing industry, i.e., the one developed by Brazilian interests and entrepreneurs, and draws from real case experiences, in the area of Sao Paulo, in the period starting at the end of the last world war.

2. SOME ASPECTS OF THE BRAZILIAN ECONOMY

The map of Fig. 2.1. presents the relative position of Brazil in South America: about half of the area, half of the population, and half of the gross national product [1]. The map of Fig. 2.2 shows the main regions of Brazil [2]. The Northern Region plus the Center-West Region correspond to 64% of the total area of the country, with less than 10% of the population. The new capital, Brasilia, now with more than 750,000 inhabitants, has contributed to the increase of the population of the Center Region of the country; the triangle formed by the cities of Brasilia, Goiania and Anapolis represent a total population of 2 million inhabitants and constitutes a pole for the colonization of a vast hinterland. The main cities in the Northern Region are Belem (800,000 inhabitants) and Manaus (700,000 inhabitants). The Northeastern Region corresponds to 18% of the area and 30% of the population of the country; 60% of the Region is a dry country suffering from irregular and insufficient rainfall. The Northeastern Region has three metropolitan areas with more than one million inhabitants each: Fortaleza (1,300,000), Recife (2,000,000) and Salvador (1,500,000). The South and South-Eastern Regions comprehend another 18% of the total surface of Brazil and 60% the total population. Its main metropolitan areas are: Sao Paulo, with 10 million inhabitants (7,100,000 in the City of Sao Paulo); Rio de Janeiro, with 8 million

FIG. 2.2



BRASIL

* 1975, estimation

inhabitants (4,800,00 in the city of Rio de Janeiro); Belo Horizonte, with 2 million inhabitants; and Porto Alegre, with 1,800,000 inhabitants.

Most of the agricultural and industrial production of the country comes from the South and South-Eastern Regions; the Center-West and Northern Regions represent a vast expanse for new cattle raising and agricultural projects, and the Northeastern Region still represents the "poverty belt" of the country which exports excess population to the other regions. The average per capita incomes of the different regions reflect the above observations (see Fig. 2.2).

Table 2.1 shows some indicative figures of the industrial growth of the country since 1930; it shows also that the Brazilian industrial development is of quite recent origin.

3. EXPERIENCES IN THE ACQUISITION OF TECHNOLOGY BY BRAZILIAN MANUFACTURING COMPANIES

A Brazilian industrial Group, with whom the author was associated for more than 20 years, has been engaged since 1945 in the building and the operation of several manufacturing industries, in the metropolitan area of Sao Paulo. It started to build, in 1945, a plant for the manufacture of railway rolling stock, that included a steel foundry for the production of truck bolsters and side frames, of couplers and of draft-gears for freight cars, and a car shop; later a railway axle production unit was also installed in this same plant. In 1952, the Group started the development of a drop-forging plant which expanded in later years to become one of the main suppliers of forged parts for the Brazilian automotive industry. In 1955, a new plant was started to manufacture pressure vessels (heat exchangers, reactors, direct-fired furnaces and boilers) for the petroleum refining and the petro-chemical industries. Three years later, the Group started the erection of another plant for the manufacture of rear axles for the Brazilian automotive industry. More recently the Group has been expanding its manufacturing facilities and has built other plants, including one for rear axles for tractors, and one for railway passenger cars.

Such an astounding variety of techniques and of engineering know-how has required a well balanced plan for drawing both from local and from foreign technological capabilities (see Table 3.1).

Table 3.1
Real case experiences of acquisition of technology by Brazilian manufacturing companies

1--Starting in 1945-- A plant for the manufacture of railroad rolling stock.

(a) Steel foundry for cast freight trucks, couplers and draft-gears: Technology acquired through a contract of license and technical assistance;

(b) Carshop: Technology developed without technical assistance agreements;

(c) Railway axle plant: Technology developed without technical assistance agreements.

TABLE 2.1 SOME SERIES OF BRAZILIAN INDUSTRIAL PRODUCTION

	Electric Energy (Kw)	Steel (tons)	Cement (tons)	Automobile and other vehicles
1930	778,800	21,000	87,160	0
1940	1,243,900	169,000	744,673	0
1950	1,883,500	690,000	1,385,797	0
1960	4,800,100	2.219,000	4,417,788	133,078
1970	11,233,400	5.390,000	9,002,000	416,394
1975	19,056,000	8.308,000	16,736,458	920,834

2--Starting in 1952-- A drop-forging plant for automotive parts. Technology developed without a technical assistance agreement.

3--Starting in 1955-- A manufacturing plant for pressure vessels for the petroleum refining and petrochemical industries.

o Agreements for the purchase of the basic designs.

4--Starting in 1958-- A plant for the manufacture of automotive rear axles.

o Joint venture with a minority participation of an American manufacturer.

o Technology acquired through a license and technical assistance agreement.

For the railway rolling stock plant, while the design and the manufacturing methods for the freight-car bodies was wholly developed locally, an agreement for a license and technical assistance was made with an American company for the development of the trucks, couplers and draft-gears. According to the agreement, the American company has trained three Brazilian engineers in its own shops; supplied the product designs and specifications; provided drawings, instructions and standards for every manufacturing step, including inspection and testing methods; and provided a senior metallurgist and a master pattern maker for the first year of operation of the steel foundry shop.

The second plant, the drop forging plant, was developed by local engineers, a fact that is noticeable because it was the first of its kind in the country. In this development the Brazilian technicians had substantial technical help from the multinational automotive companies that were installing manufacturing plants in Brazil, as well as from the foreign suppliers of the forging and die-making equipment.

As for the pressure vessel plant, the Group made an agreement with an American engineering company for the supply of the basic designs, and developed locally the mechanical designs and the manufacturing methods.

Finally, for the production of the automotive axles, the Brazilian Group negotiated with an American company a joint venture in which the American partners subscribed 30% of the stock, thus providing part of the funds for the importation of the necessary equipment. The new company made a technical assistance agreement with the parent American company, which comprised not only the supply of the necessary drawings, specifications and production plans for the various parts and components, but also a very extensive program for training Brazilian technicians in the U.S. and an intensive participation of some key American technicians in the initial phase of operation of the new plant, due to the complexity of the products involved.

During all those years, innumerable other industrial projects were being developed in Brazil. In the earlier years, only the very big projects would involve the retaining of an engineering firm; more recently this has become the rule, because the complexity of the projects has increased and also because of the growth of several Brazilian engineering companies. In general these companies will contract the whole project and, when necessary, will sub-contract some items with foreign specialized engineering firms.

Besides the petroleum refining industry, the heavy steel industry is in large part controlled by state-owned companies. In the petroleum industry this is due to a legal monopoly, but in the case of the steel industry it seems connected to a lack of interest from the private sector, because of the large long maturing investments necessary and of the considerable foreign loans required for the importation of the equipment involved.

The chemical industry is largely controlled by foreign and multinational companies, because of the proprietary processes resulting from their strong R and D activities abroad. The same is true for the modern electronics industry. Recently, the Government has been fostering the tripartite joint venture scheme mentioned above, in an effort to attract the necessary technology and at the same time secure a national participation in these industries.

The same multinational companies that lead the development of the automotive industry in the U.S. and in Europe control this industrial sector in Brazil; but their suppliers constitute a large automotive parts industry where Brazilian and foreign enterprises are competing and prospering side by side. In most of the sectors of the manufacturing industry this free competition between Brazilian and foreign private companies is a rule.

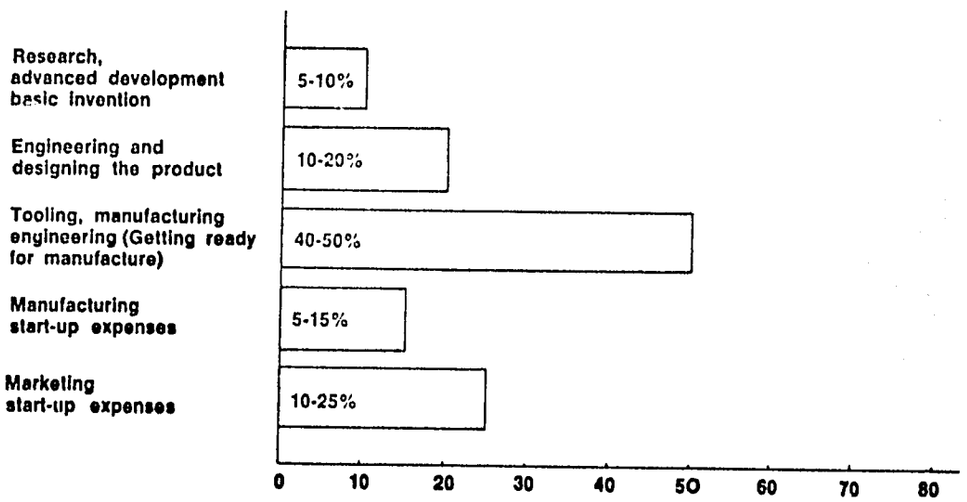
4. THE CONTENTS OF AN INDUSTRIAL TECHNOLOGY - THE ACQUISITION OF TECHNOLOGY

The graph of Fig. 4.1, taken from R. Charpie through a citation in Graham Jones' "The Role of Science and Technology in Developing Countries" [3], constitutes a good basis for the analysis of the contents of a commercial industrial technology and for the discussion of its application in a developing country. The transfer from abroad of a commercial industrial technology may cause in the economy of a developing country many of the effects of a true technological innovation and can be considered as a relative or secondary innovation. Its contents can be described in terms of the technical functions represented in the three intermediate bars of Fig. 4.1: (a) product design and engineering, (b) conversion process engineering (tooling-up), and (c) manufacturing engineering.

In a true innovation, the product design and engineering function is performed in two steps. In the first step, the product engineers, working very closely with R and D and with marketing, develop the general specifications of the product, as related to form and performance, and experiment with one or more prototypes. In the second step, the general specifications are translated into the manufacturing language, i.e., drawings and technical specifications [4]. In general, a commercial industrial technology incorporates only the results of the second step -- the product drawings and technical specifications.

FIG. 4.1

TYPICAL DISTRIBUTION OF COSTS IN SUCCESSFUL PRODUCT INNOVATIONS



Source: Charpie, Technological Innovation.

The conversion process engineering function deals with the study of the unit operations and process charts involved in the manufacture of the product, and with the specification of the industrial equipment necessary considering both the levels of production and of quality to be attained. In general, the commercial industrial technology includes the process charts, the operation sheets, and the specifications of the raw materials and of the industrial equipment. In special cases, more frequent in dealing with chemical products, it can require special process equipment of proprietary design; that is, it may contain a sort of a "black box" or something that is not acquired. The technology is transferred to us, and we get the basic designs of the equipment, but we don't get a handle on how to redesign an equipment if we need to.

The manufacturing engineering function includes the study of the procedures for the day to day activities of production planning and control and of quality control. In general, these questions are thoroughly detailed in a commercial industrial technology and references are made to the relevant fundamental texts available, because the recipient of the technology must be capable of making the necessary daily adaptations in a rational way.

In many practical cases one may want to *assemble* his own *complete* commercial industrial technology, acquiring different parts from different sources, possibly by different methods. Or one may need only to acquire improvements for a basic technology one already masters. In Table 4.1, I tried to list the different ways of acquiring technology. The list is not exhaustive, and I think that everybody involved in the technology business will eventually use each of the different ways described in Table 4.1, if not to acquire, at least to compare the technology he is using with that of the actual and potential competitors.

Table 4.1
Acquisition of industrial technologies

Through one or a combination of some of the following ways:

1. R and D
2. Technical Information
   - o Books and Magazines
   - o Foreign and International Standards and Specfications
   - o Technical Information Services
   - o Commercial Technical Catalogs
3. Training Personnel
   - o Training Abroad
   - o Importing Technicians
4. Analysis of Embodied Technology
   - o Importation of Foreign Products (For copy and adaptation)
   - o Importation of Foreign Special Process Equipment (to learn about Special Conversion Processes)
5. Contracts of Purchase of Technology
   - o Licensing of Patents (Includes Disclosure of Peripheral Technologies)
   - o Technical Assistance (Includes Product Design)
   - o Engineering Projects and Services

Referring now the four real case Brazilian experiences presented in the Section 3 above, one can make the following generalizations:

(a) The two cases of purchase of a *complete* industrial technology (the first for the production of cast steel freight car parts and the second for the production of rear axles for automotive vehicles) correspond in fact to major product innovations (relative) in the country.

(b) The examples where the necessary technology was *assembled* from different sources correspond to manufacturing operations where the product designs were specified by the clients; this is true even in the case of the manufacture of freight-car bodies, where some important adaptations had to be made. We can assemble a technology whenever we don't have to develop the product design and also in those cases where you do not have a complicated process.

(c) In one case, the manufacture of the pressure vessels, all we had to import (and we still have to import) is the basic product design. We developed our own methods for mechanical design, manufacturing, and quality control, completely.

In conclusion, the main obstacle to a complete "nationalization" of the technology involved in the real cases cited, including the two cases of major (relative) innovations, is connected with the lack of capability in the product and process design and engineering function. And I believe that this capability can only be developed through an R, D and E approach, that is, through the interaction of the engineering groups with the R and D capability.

KNOWLEDGE REQUIRED TO APPLY AN INDUSTRIAL TECHNOLOGY

In the real case examples examined in the preceding section, the knowledge needed to acquire the different necessary industrial technologies has consisted essentially of sound engineering knowledge, the industrial technologies being expressed in terms of the engineering language -- drawings, standards, specifications, process charts, plant lay-outs, operation sheets, and testing procedures. But the application of each industrial technology has always required some input of local research, even when this technology was wholly purchased abroad, because of the necessary knowledge of the most diverse materials needed to build and to operate an industrial plant.

To operate an industrial plant you must also have available locally a large diversity of skilled personnel, like mechanics, tool makers, electricians, plumbers, etc. In these aspects, the industrial area of Sao Paulo was in a favorable position, when the speed of the industrialization of the country started to increase. It had skilled personnel, because the thousands of immigrants that came from Europe, attracted by the coffee plantations of the State of Sao Paulo, had included a large number of skilled technicians, many of them with entrepreneurial capability. In fact, their "back-yard industries", as their small factories were called, reached such an importance that since the early thirties the city of Sao Paulo boasted of being "the biggest industrial park in South America". Later, the training of skilled workers was undertaken on a national basis by an institution organized and maintained by industry. On the other hand, the local engineering school -- Escola Politecnica de Sao Paulo -- that was founded in the last decade of the past century, has shown since its beginning a strong capability for the development of a good laboratory basis for the study of the local materials and natural resources. Its young engineer graduates were initially attracted by the needs of the railroad and highway construction, by the growth of the local electric power network and by the building of the city of Sao Paulo, but soon started to show interest in the manufacturing industry. As an out-growth of the engineering school, an institute for technological research was founded in 1934, the Instituto de Pesquisas Tecnologicas -- IPT for short -- with the objective of supporting the industrialization movement.

The combined influence of the two institutions -- the Escola Politecnica and the IPT -- in the industrialization of the country has been studied by Prof. Dr. Carneiro, Jr., in a work at the Institute for Latin American Studies of the University of London, published in February, 1970, under the title: "The Development of Technological Progress in Brazil -- a case study: IPT's role in adapting, transferring and creating technology". From this work of Prof. Carneiro I quote the following excerpts, with some of his findings and conclusions: "Research was started (then) in several areas of chemistry, in metrology, in industrial standards, building structures, soil mechanics, and high quality plywood" ... "IPT did also pioneer's work in different specialized areas of metallurgy, ferrous and non-ferrous alike" ... "Its permanent assistance was vital to the motor industry and all sectors of different engineering industries when they went into production in the country" ... "By its initiative, the Brazilian Association for Technical Standards (ABNT) was formed and several industrial standards were first drafted at IPT" ... "Technicians from several Brazilian states and firms and from other countries in Latin America worked there for varying periods, being trained in different industrial

techniques. Finally it also turned into an important source of entrepreneurial talent, many of the Sao Paulo leading industrial leaders having done several months or years of training in its laboratories" ... "these men are or have been front rank entrepreneurs in important industries and financial groups".

The support of IPT to the growing industry was provided through specific services of the following categories:

--Tests and chemical analysis.
--Industrial metrology.
--Research on specific problems and trouble shooting.
--Pilot plant experimentation (in some industrial sectors).
--Training of personnel in the laboratories and experimental stations.
--Technical assistance and consulting.

When you consider the problem of acquiring industrial technologies you have also to consider the organization and maintenance of some local institutions whose support may be of the utmost importance to the practical use of those technologies. In the case of the industrial development in the area of Sao Paulo, an engineering school and an industrial research institute, both stressing the need and the advantages of objective laboratory measurements and experimentations, have been the key local institutions. I am emphasizing the adherence to a basic experimental orientation of the two above institutions, because I believe that Sao Paulo constitutes an early example of local reaction against the generally prevailing discursive-rhetorical characteristic of higher education in Latin America. In 1899, the founder of the Escola Politecnica, had specified what he expected of the new school, in the following words:

(The Sao Paulo Engineering School's) "main objective is to prepare people to do and to act, rather than to discuss and digress". [5]

I tend to believe, also, that those institutions, besides acting as a basic support for the acquisition of industrial technology by Brazilian enterprises, have also largely contributed to attract the foreign and multinational companies that operate in the country, most of them settling in the area of Sao Paulo. This is in agreement with Prof. R. B. Stobaugh, Jr., of the Harvard School of Business, who considers that what he calls a "local technology" represents a very strong factor in the choice for the location of an industrial affiliate abroad [6]. I would add as a commentary that in the case of Sao Paulo, very few of the foreign and multinational corporations located there have done anything to help the strengthening of those institutions.

6. THE ACQUISITION OF TECHNOLOGY BY BRAZILIAN INDUSTRIES - A CHANGING PICTURE

The industrialization of the Country, made through the combined efforts of the national private enterprises, the foreign and multinational corporations and the state-owned companies, has significantly strengthened and developed the Brazilian internal economy. But since the sixties there has been a mounting preoccupation with the growing external technological dependence of the country. Some of the more objective preoccupations are related to:

I - Problems with engineering projects contracted abroad. A project developed in a given foreign country will tend to specify the construction materials and the industrial equipment according to what is used in that country. This may cause the importation of components and of equipment that could otherwise be manufactured in Brazil.

II - Problems with licensing and technical agreements. They may contribute to the capture of Brazilian private industries by foreign companies:

(i) Some foreign companies have used a technical assistance agreement with a Brazilian company as a way of exploring the size and the importance of the local market; at the end of the term of the agreement, they have exerted pressure upon their licensee to sell the industry, or simply put up a factory in the country, in full competition with their former licensees, leading them to bankrupcy.

(ii) Some local companies that wanted to acquire a certain technology to support the evolution of their Brazilian market, have met as an answer from the few foreign companies that controlled said technology that they were not interested in an agreement "because they wanted a free hand in the growing Brazilian market".

In both cases, the Brazilian companies have found that "technology" is not a regular commodity that can be bought in the open market. It is, indeed, a different sort of a commodity, that a foreign company can produce and not sell, or it may sell and still keep it.

III - The tendency of perpetuation of some technical agreements. In general the Brazilian industry after contracting an assistance agreement finds itself in a conflicting situation. On one side it would like to get free of the payments involved as soon as possible, but on the other side it tends to prolong the agreement because:

(i) It fears to acquire a competitor - either a branch of the licensor or another Brazilian company that could take its place; and

(ii) It fears to lose the access in the future to some eventual innovation the licensor may develop. What is not generally understood is that the Brazilian licensee frequently adds a third reason to the perpetuation of the license.

(iii) It derates its own process and product engineering department to the mere functions of translating, interpreting and detailing the drawings and technical procedures received from the licensor.

IV - The lack of ready-made technologies for the exploitation of the nonconventional natural resources of the country. Many of the Brazilian mineral, forestry, and agricultural resources are considerably different from those of the industrialized countries, and in these cases their industrial use will depend upon a work of R, D and E that cannot be expected to be made outside of the country. This is the case, for instance, of some very complex mineral bodies, of the high ash coals of the southern part of the country, and of the charcoal plantations of the center east part of the country that supply almost half of the Brazilian steel production. And as we try to develop local substitutes for the imported petroleum the number of such cases will certainly increase.

I don't believe that many of the problems presented above can find a definite solution. Many of them represent conflicts of interest that have to be dealt with on a day to day and a case by case basis. But I believe that a steady strengthening of the Brazilian R, D and E capability will increase the self-confidence of the Brazilian companies and will create a better climate for a mutual understanding between the foreign suppliers of technology and the recipient local industries. It will also help in the development of the general economy through the increased industrial use of the local nonconventional resources above mentioned.

A way of doing this could be through the strengthening of research institutions like IPT. In the past five years IPT has lived a very interesting experience of working in many projects together with American institutions, through a loan agreement with USAID. One of the American institutions has been our host today, the U.S. National Bureau of Standards. Brazil has now a good number of flourishing research institutions, and I believe that a bigger long term plan could make them all profit from the experience, the capability and ingenuity of the American Universities and research institutions, in the development of a sound R, D and E basis for my country.

References

[1] IBD (Interamerican Development Bank) - Social and Economic Progress in Latin America (1976).

[2] IBGE (Brazilian Institute for Geography and Statistics) - Sinopse Estatistica (1977).

[3] Jones, G., The Role of Science and Technology in Developing Countries (The International Council of Scientific Unions, London, 1971).

[4] Timms, H. L., The Production Function in Business (IRWINN, Inc., Homewood, Ill., 1962).

[5] IPT, Meio seculo de tecnologia, Bul. 34 (1950).

[6] Stobaugh, R. B., Jr., Where in the world should we put that plant?, Harvard Business Review (Jan./Feb. 1969).

PAPER 7.3 - THE ROLE OF TECHNOLOGY NEGOTIATORS

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1. INTRODUCTION

First, I would like to add my thanks and my gratitude to that of the other speakers in commending NBS and AID for the splendid organization of this program. I have participated in a number of programs on the transfer of technology, and I am delighted to see the emphasis in this one on some of the specific technical infrastructure of the subject. I think that is a topic that is too often neglected in favor of other aspects.

I would like to elaborate a little bit on my own background. I have been asked, "Why a lawyer in this program, amid so many engineers and scientists?" I have had a little involvement myself with standards, going back to my days in the defense and aerospace industries, which those of you here in the NBS and other U.S. Government organizations will particularly appreciate. It goes back to cutting my teeth on ANMS and NAS and Milspecs, when I was working in the defense and aerospace industries. And I have been involved (for a lawyer) in a rather extraordinary number of aspects of the production process, from the receipt of raw materials and parts on the receiving dock, tracing the receiving reports into the materials operations departments, and through to inventory control and production control, and all the way up to the Project Offices of various large systems and hardware projects, in those industries, and so on. I am told that I speak "engineering" to some degree, although I am not an engineer myself.

I am not going to confine my remarks to the role of licensing negotiators, but to speak more broadly of technology negotiators, because as you have seen demonstrated by the previous presentations, technology is transferred in a variety of ways, not simply in licensing agreements. Part of my experience was as International Counsel for a large process engineering firm that built processing plants all over the world, serving a number of the processing industries.

Technology is transferred through direct foreign investments, in my view, probably more than any other means. It is transferred extensively (I agree completely with the previous speaker) through the supply of detailed and basic engineering. It is transferred through the supply of technical assistance and technical services agreements, management assistance agreements, and, of course, through the licensing of patents, trademarks, and, particularly, unpatented know-how.

In the process of technology transfer attention has shifted from the sources of technology and attempts to control and regulate both access to and the supply of appropriate technology for economic and social development, to the capabilities of the receiving infrastructures to properly select, absorb, utilize, assimilate, and improve upon technology for industrialization, or in other words, to acquire it for effective use. This point in the entire process -- the negotiation of the agreement for the technology and its transfer -- is perhaps a threshold, and the effectiveness with which principal actors discharge their responsibilities will have a substantial impact upon the effectiveness of any particular transfer, and the contribution of the technology to the industrialization process. Let me be a bit more specific.

2. IMPORTANCE OF NEGOTIATION TO SUCCESSFUL TRANSFER

Once a recipient country identifies a need within its development plan, it invariably undertakes the necessary activities to identify technology which will be suitable to fill that need. The host government, or the appropriate productive sector enterprise, directly or by retaining a consultant, will survey the available data, and prepare parameters or specifications which must be met in order to fill the need and accomplish the objective. For example, in the context

of an import substitution model, studies may have identified substantial expenditures of scarce foreign exchange on particular chemical products which have been imported for use in the industrialization process. The determination is made that the raw materials exist within the country. The decision is made that a chemical processing plant should be built, and a location is determined by a feasibility study. The study may take into consideration national policy to diversify industry away from highly concentrated areas in order to create employment opportunities in other zones, thereby reducing population pressures on major urban centers. Research indicates that processes owned by several of the leading Transnational Enterprises (TNEs) would appear to be suitable to the constraints and parameters identified before and during the feasibility study. Specifications are then prepared for an international tender. The documentation is made available to a substantial list of enterprises for whom data indicate that capability exists to produce the facility.

Nine (9) enterprises respond, with elaborate proposals, to design and construct the appropriate chemical processing plant. The bids are evaluated and for various reasons, four of the nine are eliminated for non-responsiveness. Of the remaining five, a determination is made that the proposal submitted by company 1 is the most attractive from a technical, economic, and social point of view. Company 1 is thus selected, and the others are ranked in descending order as to desirability, 2 through 5. Company 1 is notified that its proposal has been selected, and it accepts the offer to begin negotiations for a contract to design and construct the plant.

There are obvious conflicts in this situation before the negotiations begin. The host government is, to a degree, dependent upon the TNE for the technology to be supplied to accomplish the country's industrialization goals. Yet the TNE is seen as a creature with worldwide presence, foreign control, and ability to raise capital and other resources in foreign markets, seemingly without allegiance to a single country. The perception is, that lacking this allegiance, government to government pressure would not necessarily be successful in the event difficulties or disputes arise (as they inevitably do) during the project. The TNE is seen as transcending the sovereign interests and limits of the host country.

The stage will be set in this negotiation for the relationship between the technology supplier and the host country. The adoption by both parties of a long-term mentality will help to provide a climate of stability and mutual benefit, such that difficult decisions at crucial stages will be resolved in favor of a successful transfer. These decisions often have negative economic consequences for the technology supplier, in the short term. Thus, the negotiating posture, particularly that of the host government, as well as the strategy and tactics employed, will have a direct bearing on whether a climate of mutual trust and confidence is created. This, in turn, will directly affect the speed and efficiency with which the technology is transferred -- how quickly and how well the chemical plant will be built -- and the degree of commitment by the supplier to the complementary but essential elements of the transfer process, including training and subsequent maintenance and support of the plant.

3. UNEQUAL BARGAINING POWER -- RELATION TO KNOWLEDGE BASE

When the recipient is a local private sector organization, as opposed to a government agency, there is less of a tendency for the subliminal conflict in perceptions to arise. Generally, there is more of an acceptance of the necessity for dependence upon the foreign technology supplier, at least in the early stages of the project. In either event, it has been common in recent years to refer to inequality of bargaining power between the recipients and suppliers as one of the major reasons for political attempts to restructure the process of technology transfer.

Inequality of bargaining power arises, in part, from inequality of knowledge and experience. Increasing the knowledge base, the theme of this conference, is thus a prerequisite for ultimate equalization, or at least realignment, of bargaining power. In the interim, however, among the most

successful approaches to equalization include the adoption at the outset of the long-term approach and attitudes referred to earlier, toward developing a mutually productive and beneficial relationship with the supplier. The adoption by both sides of such a long-term mentality facilitates the creation and development of mutual trust, as mentioned. The TNE must view the transaction as a partnership, whereby it is becoming a citizen of the host country, and it is undertaking a commitment to economic and social development (through building an efficient plant which adds value to existing raw material resources), in return for a satisfactory profit. The host government should look upon this relationship in a similar way, and should exert dedicated efforts to maintain a climate of stability such that the TNE does not believe that it will place in jeopardy the allocation of its human and material resources toward the accomplishment of this project. Such a climate of stability has been increasingly lacking in recent years in various parts of the industrializing world.

The use of consultants is highly recommended for the technology recipient. Consultants have long been employed by TNEs in technical capacities to supplement their existing technical expertise. This also lends additional prestige to the supplier, since the consultant usually has established a favorable international reputation. This is urged for the recipients as well, including host governments. The analysis of the technical proposal submitted by the TNE requires an intensive qualitative dimension, in addition to the quantitative now being discussed by the Technology Registries and other appropriate government agencies in certain developing countries. In other words, at the present time, one of the major criteria for determining acceptance and registration of technology agreements by a host government is whether the royalty rate is too high. What is far more important, however, is the quality and distinctive or unique characteristics of the technology, the determination of whether it is appropriate to the needs of the country, and whether it is suitable or adaptable to the market into which the technology is being transferred. No technology is appropriate if the infrastructure is not capable of receiving it, absorbing it, and utilizing it effectively, and, ultimately, improving upon it.

In addition, recipients should begin to employ as consultants the experienced negotiators who have insight into the operations, thinking, and negotiating tactics of TNEs. Many of these professionals are available but are not being utilized for a variety of reasons. These people are often seasoned professionals, including economists and lawyers, and would be totally loyal to the client that hired them for the particular assignment. The employment of technical and negotiating consultants by technology recipients would lead to more productive and shorter negotiations and fewer misunderstandings. The cost of the consultant's fee would be recovered many times over the life of the project, and can be financed with the project.

In the long term, several international organizations are actively conducting programs to train developing country government officials in the art and science of improving their negotiating capabilities with TNEs. These are the TCDC programs, with which Mr. Baron is involved. In addition to capacity for negotiations, however, practical experience in the technical discipline involved is essential to appreciate the type of problems which normally arise in the course of these projects. While this capability is being developed, there would appear to be no better interim solution than the prudent deployment of consultants.

Another important strategy to equalize bargaining and accomplish negotiating goals includes the granting of various important negotiating trade-offs in return for necessities and to more readily encourage more effective transfer. For example, various kinds of incentives can be granted to a technology supplier, including tax incentives and others, in exchange for the requirement that the TNE commit itself to and carry out a mutually agreed-upon program of training, both in the host country and in the home office of the technology supplier, with access to the kind of facilities and environment which would provide an entirely different dimension of training for the technician who will eventually be operating

the plant. This "hands-on" training is an important element to accomplish an ultimate objective of increasing the skill levels across the broadest sectors of society.

Another tradeoff could be the establishment of small R and D or adaptation centers, involving only 2-3 people, in the host country, to perform the well-known development engineering function, so well perfected by technology suppliers, in the particular environment of the host country. These would employ one or more local technicians or engineers and would provide the kind of outstanding training that would be directly relevant or valuable for increasing the skill level and providing an upgrading of the knowledge base.

4. CONFLICTING OBJECTIVES OF SUPPLIERS AND RECIPIENTS

In addition to the conflict in perceptions which sometimes exists, and the inequality of bargaining power, the recipient enters the negotiating arena with a defined set of objectives, whether government or private. These objectives normally include some or all of the following: The necessity for the importation of capital and technology for industrialization to supplement the domestic resources, preservation of scarce foreign exchange reserves, diffusion of the benefits of the imported technology throughout the economy, creation of more employment for nationals and location of plants in labor-surplus areas, avoidance of unsuitable or irrelevant technology (developing countries often need more labor intensive as opposed to capital intensive equipment or technology with some exceptions), avoidance of overcharges and restrictions on the confidentiality and use of the technology, and compatiblity with existing environmental and energy policies of the host government. The general objective expressed by leaders of many developing countries is to obtain the technology outright or purchase it, rather than pay continuing royalties throughout the length of what are viewed by some as excessively long agreements. The recipient will enter these negotiations aware of a history of experiences in its own and other developing countries, which may include some documented abuses in the transfer to these countries. These alleged abuses include, for example, the sale of technology without the accompanying arrangement for technical assistance. As a result, problems arise at various stages of the production process, which could involve anything from the selection and utilization of raw materials, to the organization and training of the personnel. From the unfavorable results in these cases, it has been erroneously concluded that the technology is worthless, and payment for it constitutes wasted resources. In other cases, technology which is obsolete or already in the public domain, has been sold, or charges have been made for technology which has not been transferred, or the technology transferred was simply not appropriate for production for the specific size and characteristics of the domestic market. This would include the relative availability of the other factors of production, or support items which the plant will require to function effectively (e.g., power and other utilities, roads, communications, etc.). Finally, many conditions have been imposed in technology contracts such as export restrictions or obligations to purchase raw materials, supplies, or parts (tied purchases) from the technology supplier. It is sometimes alleged that these obligations include prices higher than those prevailing in the international market. This latter has been mentioned particularly in transfers involving affiliated companies. These abuses, and it is admitted by reasonable spokesmen for many TNEs that there have been occasional abuses, have led to extreme reaction in some countries.

On the other hand, the supplier enters the negotiating arena with its own set of objectives. Some of these are in direct conflict with the objectives of the host country, and they include the following: a fair return on the investment in the R and D which has produced the technology; an increase in the market share or a new entry in a market; protection of the property rights in the technology, including patents, trademarks, and most particularly unpatented know-how, which technology suppliers also view as industrial property. It was interesting for me to view the Brazilian experience. It should be noted from the earlier presentation that Brazil did not reflect acquisition through the

license of unpatented know-how. It is well known in this country that many developers of processes, including chemical and petrochemical processes in particular, do not obtain patents for these processes, because they feel that protection through confidentiality agreements is more effective. Thus, the absence of a policy to acquire this kind of know-how through the licensing of processes, which is the case in Brazil, and it is reflected in their laws and regulations, in my view could have serious long-term implications. And finally, along with the others, objectives of the suppliers also include the necessity to control and maintain the standards, the quality level, and reputation of the supplier in the international marketplace. In this context, I was particularly interested in the quality control presentations and discussions this morning.

5. THREADING THE NEEDLE

The greatest amount of technology is transferred as an integral part of the foreign capital which flows into developing countries. This is generally seen in the form of direct foreign investment. When gaps exist in the technological capacity of developing countries to produce growth and expansion, including more employment and creation of indigenous technology, then foreign technology must be acquired to fill those gaps.

Reference is occasionally made to the Japanese Model of industrialization. The leaders of that government embarked upon an organized course of action to repair and rebuild their economy after the Second World War. They established long-term objectives and goals and created the necessary infrastructure to support the accomplishment of such objectives. At some substantial initial cost and investment, they have accomplished a modern miracle within the last couple of decades. They are now leaders in technology development in many areas well known to all of you.

The Japanese Model may or may not be appropriate in any other country, but one lesson is useful from their experience. Some developing countries today are participating in efforts to enact increasingly restrictive laws and regulations controlling technology transfer, which have, in many cases, served to reduce the flow of essential technology for the industrialization process of those countries. The Japanese did not restrict such flow at all. In fact, they did everything to encourage such flow to facilitate development of their industries to the level at which they could be competitive in the international market. Today, they excel in many areas, and are the leading producers of technology in certain specific industries.

Negotiators must become sensitive to all these constraints which are present upon entering the negotiating arena. A negotiation for a technology transfer, whether by license agreement, with or without a joint venture arrangement, technical assistance agreement, turnkey project for a chemical processing plant, direct foreign investment in an automobile engine or transmission plant which would create a multiplier effect on the economy with the resultant emergence of secondary and tertiary suppliers for the manufacturing plant, or any other form, cannot be viewed in negotiating terms as a win-lose contest. Since a long-term mentality and relationship are required for successful transfer, the negotiations must be looked upon as a win-win situation. There must be mutual benefit, and there must be commitment by both parties to assure successful transfer. This means that the host government must make a commitment to simplify whatever bureaucratic obstacles may ordinarily delay the completion of this plant. As noted earlier, the TNE must make a commitment to the economic and social development of the host country, in return for a satisfactory profit. The goals of each side should be explicitly defined, recognized, and accepted at this stage in the negotiation process. It is only at this point where the complete and candid communication of such objectives can facilitate the abilities of each party to achieve its long-term objectives.

The negotiator must obtain a commitment from higher levels of decision makers in his own organization, who will not be directly involved in the negotiating process. In recent years, with increasing efforts to

regulate and control the transfer process, the negotiator's role has become more critical. All of the tension that has been created around these efforts may create strong pressures on the negotiators to accomplish objectives, which may be viewed more as political than as technically related to the successful execution of the project, the successful acquisition of technology. In order to expand the knowledge base for industrialization, negotiators must resist these political pressures, whether in specific contract negotiations, or international negotiations for codes of conduct, or the like. The rhetoric must be left to the politicians and must be removed from the negotiating rooms. Understanding, not rhetoric, is the most direct path to the creation of the kind of relationship which will result in effective transfer of the technology, and mutual benefit for both parties.

DISCUSSION:

Mr. Owino-Okwero (Kenya Bureau of Standards):

What I want to get clarified concerns the restrictive laws that you feel are applied by developing countries, which cannot create a condition like the one you described for Japan. I found that rather signficant. Can you just amplify it a little bit, so that we know which laws we don't need to apply and which laws are acceptable, because allow me to say for my country, we have laws like, we need to participate in more joint ventures coming in as a country, through a governmental organization, which does 50% financing, etc.

Mr. Radway:

I would be delighted to do that. Some of my clients, suppliers of technology, would say, the best laws are no laws. It is not the law that is going to encourage economic development. If a need is determined to enact a legislative structure, laws and regulations or policies, in order to provide a climate of predictability and certainty, which is usually spoken of as being desirable for private foreign investment and technology suppliers, then I would suggest that a balance be struck. I am not saying that some of the laws that have been enacted in the last decade, in particular, are totally irrelevant. I think that the majority of Transnationals today recognize the benefit for host countries to screen and control and regulate to some degree the transfer of technology.

However, in the enthusiasm and the eagerness to control the source of technology, as opposed to the process or the acquisition of technology, a lot of laws were enacted which prohibit certain kinds of agreements or certain kinds of clauses in agreements. Nearly three years were spent at UNCTAD negotiating the so-called restrictive business practices. The group of 77 tabled a draft of 40 restrictive business practices, that in their view should be prohibited from any agreement involving transfer of technology. But in fact, a lot of these so-called restrictive clauses provide guarantees. Tied purchases, while allegedly restricting the recipient of technology to one source, at the same time guarantee that recipient access to a particular quality level of supplies and raw materials, and personnel, as long as the prices are those of the prevailing international market. Note that kind of a provision has in fact recently been written into certain laws of the developing countries, where previously more restrictive laws were reversed.

In other words, what I am saying is, a balance should be struck. A lot of the rationale behind the so-called restrictive business practice discussions, or rhetoric, related to the antitrust laws existing in the United States, the European Common Market, and Japan. Well, these laws are highly sophisticated economic principles, based on application in highly developed, highly sophisticated marketplaces. These laws are almost totally irrelevant for application in far less sophisticated marketplaces, in less industrialized societies. In addition, in the process of economic development, it is very often essential to erect protective barriers, to promote investment in new industries. So, protection of certain kinds of new investments -- pioneer industries, as they are called in the laws of many countries -- is essential to create industrialization in certain sectors. Well, this kind of

protection and the promotion of competition, which is the purpose of antitrust laws, are totally inconsistent. So the idea of referring to the antitrust laws of the United States and the EEC, is in my mind, really just another set of confusing, irrelevant issues.

A balance can be struck with the requirement for screening of technology transfer agreements, for registration if that is desired by the host government, in order to monitor balance of payments and areas where abuses may occur, but flexibility must be written into the law and into the policy of those people who will be applying the law. Now this has taken place in certain countries with these kinds of laws, and their experience with the flow of technology is far more attractive, far better than other countries, which do not have this desired degree of flexibility. You can put guidelines around royalty rates, and levels of technical assistance fees for different kinds of industries, but you cannot cast them in concrete, because there are always exceptions where technology is unique. Some laws have been written for very ordinary technology, almost public domain technology, and then those laws are applied to unique technologies. It just doesn't work. The rule of reason, a flexible approach, has to be written into these policies, in order to be able to attract the desired technology and screen out the excesses.

Laws may require a joint venture between foreign technology suppliers and local interests, and the latter may be a government organization. There may be rules with respect to percentage of financing from local sources, and with respect to nationals employed in both managerial and production capacities. What I am suggesting is that such laws, if they are a political requirement, must contain the flexibility to structure the entity to be able to breathe and live, not to choke and die. If the law requires local participation, then sufficient resources (economic and human) must exist in the specific sector and level of sophistication to be capable of blending with the foreign component to form a viable organism capable of working efficiently to meet the objective. There must also be sufficient mutual interaction to facilitate the long-term compatibility mentioned earlier.

PAPER 7.4 - A PUBLIC INTEREST POINT OF VIEW OF SCIENCE AND TECHNOLOGY FOR DEVELOPMENT

James Gudaitis
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In a way, I feel somewhat out of place here, representing a public interest group, in the midst of so many people who are specialists in a specific area. I feel somewhat like a developing country, if you will excuse the analogy, talking to the industrialized countries of the world. I have very narrow or am just beginning to develop a technological infrastructure, and I look upon you as having a very extensive one. And yet, at the same time, I feel like I can contribute something. I have expanded and developed other areas, maybe, that with limited resources I am still interested in expanding and developing; whereas you sometimes, with your technology, which seems very attractive, may be offering a route that I do not necessarily want to proceed along.

The potential of technology, as it now exists, is rather unlimited, as has been said, and it seems like the only things that are restricting it at this point are the political will and possibly the limitations of resources. Now, there is no doubt that science and technology do have positive benefits: increased life expectancy, increased economic growth, etc. But at the same time, the overemphasis on technological growth has given rise to serious imbalances within the global perspective and to problems in certain areas.

Three of these problem areas are in development, where we see unemployment, urban congestion, and other drawbacks; in ecology where we have pressure on and wasteful use of limited resources; and in security, where an unnecessary amount of resources is being put into military expenditures, the channeling of these resources into armament production. Now, the problems caused by these imbalances are further complicated by three other factors: the increasing population, the recognition of a finite limit of resources, and an awareness of a growing global inter-relatedness.

One of the things that has been recognized at the UN is an expanding concept of development. It no longer is limited to economic growth, but is beginning to include such things as man's cultural diversity and a more social aspect of development. One of the things we must continually remind ourselves about with this perspective, is what types of goals are we actually looking for? What is it that we want technology to do? And to this extent, we must realize that technology is not an end in itself, which this conference may almost -- with, you know, little attention being paid to anything else -- seem to indicate, but that it is a means to an end. And at the same time, technology is not the only means to the specific goals of a country, but is one of many. There would be other alternatives. Now, granted the complexities of things, like improving the quality of life, which may be a desired goal by a national country, it will be necessary for us to expand the economic growth, but at the same time we must be willing to consider the need for a country to want to emphasize cultural diversity and other such things.

Now what I want to do is to only mention some of the questions that would have to be raised, when we look at the development of a technological infrastructure, and technology transfer. One of these would be, "How does this, as a developing country, influence my self-reliance and autonomy as a country? What are the future implications of the transferance of this technology? Will it affect the ecological systems of my country?" One of the things that is being discussed, and it is a very complicated issue, is the exportation of hazardous technologies from the more developed countries to developing countries, whereas they have a desire for a specific type of technology, which we have found hazardous and have limited in our country, but by exporting over there we seem to be able to get away from a lot of things.

Another thing would be the opportunity for employment and income distribution. Many of the arguments for appropriate technology have fallen under the guise of "better, more

equitable distribution of resources, and employment for many". Now, what type of technology is appropriate for a country is dependent upon what that country's specific goals are. But among those, it would seem like you could have a high technology approach as long as you consider the implications for employment of the people and the income distribution of those resources and the benefits paid by the adoption of a certain technology.

What types of security are needed? Is the imbalance or overemphasis of resources into armaments having a detrimental effect on my country's production? And is it taking away from some of the social goals and the meeting of basic human needs that I would think necessary?

Finally, am I allowed as a country to develop the type of technological infrastructure that I would find adequate? Or have I decided to buy a Western approach, the entire Western approach to high technology and things like that? My emphasis again would be on cultural factors.

I would like to close by saying, using again the analogy that I am a developing country, that I have gained a lot by being here among people who have a very specific interest in the development of high technology. At the same time, because of my own desire for possibly other aspects of what I consider a more holistic approach to my development, I think maybe my emphasis on cultural diversity may affect your own interests in where you want your development to go, so that you do not just emphasize economic growth.

DISCUSSION:

Mr. Baron:

I think that Mr. Gudaitis has spelled out very well the point that was made earlier by other speakers, of the need to look at technology in terms of people in the country and the objectives of the country, and I know many developing countries today, in UN fora and others, are saying very similar things.

Professor Lieberman (University of Illinois):

I have been teaching for several decades, technology students, engineering students. And at the University of Illinois, we have participated in "Earth Day" and several other kirds of "Days", since they began with the local politicians, and students, and others. What we have observed, is that as you look around the audience, it is very difficult to find black students, Iranian students, Israeli students, Indian students, Bangladesh students, or any students other than people from the United States, mostly, who have "made it", and can afford to look at some of these problems.

I think that you are pointing out correctly, that if you look at them from the beginning before they get frozen in the wrong way, they will be easier to handle. However, I think it is very difficult to talk to people in the developing countries about situations -- important situations, I agree -- that are of fairly low priority at the time -- and I just don't know how you do it, really. You can't go in and say, you had better not do it this way because you will be like we were, since they will say, "Great, I want to be like you were. I want two television sets and an automobile, and then I'll take care of the pollution, just like you did. Don't tell us that we should not have all of these wonderful things."

So you are projecting what you now think is important to project, what you hope these countries will say to you. I think you will be disappointed. I think that most of them will want to outboard the full dinner pail, before they say the stream is dirty. And that's Japan. I really don't think that right now many of them think that you are presenting it right. They are not negative -- they really don't know what you are talking about. You are talking a language that has no meaning for them at their stage of development.

So I just wanted to get other comments, perhaps, as to whether my experience is indeed unique, in finding that there is not that total amount of agreement that these other issues can be considered important, at this time, in their development. They are back at the time, in terms of our own development, where a black plume coming out of a smoke stack (as in 1938) was considered success: it was generating jobs. Now, you and I look at this black smoke stack and say, "That's terrible."

Mr. Gudaitis:

I would only like to say that this requires greater participating by all concerned. In a lot of the developing countries -- I hate to generalize -- it seems like sometimes it is the governments themselves that have bought our desire for technology and industrialization. But sometimes, if you go into the villages themselves, they have not yet been inculcated into the Western ideologies, and our public relations job, and are willing to maintain some of their own cultural traditions. And again, I would just like to say, what is needed is the participation of all involved, and in any case, we would like to caution them in these areas.

SECTION 8 - SYNTHESIS AND PROJECTION - GUIDANCE FOR THE U.S. IN THE UNITED NATIONS CONFERENCE ON SCIENCE AND TECHNOLOGY FOR DEVELOPMENT, AND BEYOND

Chairman: Dr. Edward L. Brady, NBS Associate Director for International Affairs

A. Dr. Edward L. Brady:

We have had two days of talks and discussions. Now we want to see what sort of instant conclusions we can come to as a result. Of course, Proceedings of this seminar will be printed and will be available for study. We hope that they will have some impact on the United States positions for the UN Conference, and certainly, we expect the Proceedings of these discussions to have an impact on the program that we at NBS expect to continue, hopefully, indefinitely into the future.

First, let me recall for you what our objectives have been in this Seminar.

First was to examine some elements of the infrastructure for technology for industrialization throughout the world, particularly in those countries that have been successful in the development of a technological industry. So you undoubtedly noticed that there was emphasis in the talks through these two days on the experience of those countries that have been especially successful, such as Korea, Brazil, Mexico, and Singapore.

Second, we wanted to see how the problems of developing a technological infrastructure appear through the eyes of people in those newly industrializing countries that have had more recent experience than we have had in the United States. We wanted to see what lessons we could learn, from the examination that people have made of these problems, and of the thought that people from other countries have put into analysis of their own problems of the infrastructure.

Finally, we wanted to ask ourselves, what should we do about it? What should we in the United States do about the problems of a technological infrastructure in the United States and in the industrializing countries, and especially what should we do about it for our preparations for the UN Conference on Science and Technology for Development?

B. Dr. Howard I. Forman (Deputy Assistant Secretary of Commerce for Product Standards):

Most of what I could say will be in the Proceedings. Rather than repeat some of the things that I have heard, I would like to do something else, which will reflect I am sure a considerable amount of what I have heard these two days. Then I want to add to it some of my personal experiences which I think might be responsive to the purpose of this particular session, which is to give guidance to the United States in the United Nations Conference on Science and Technology for Development.

First of all, I would like to borrow a page out of Mr. Radway's self-introduction, for just a moment, because I will have to qualify myself as a sort of a witness of what I am going to say in part of my remarks. Briefly, I guess this is my forty second year past undergraduate school, half of which time was in government, half in the private sector. Until 2 1/2 years ago I was with a multinational company in the United States for some 20 years -- patent counsel, international corporate counsel, and a few other things; prior to that, a chemist, laboratory director, and that sort of thing.

First, a comment on some of the things I have heard repeatedly from a number of the speakers, which reflected in my own mind answers to some of the things that have been troubling me over the past year or so since I have been in Washington, and have been attending some of the meetings that Ambassador Wilkowski has been holding. When I ask myself, Why is the United States involved in this great exercise? What is the importance to the United States in doing it, and what is the importance to the industrializing nations? (I don't like the term "developing nations", because as Dr. Baruch pointed out, we are all developing. The United States can send a man to the moon, but we still have to develop. And everybody else is doing that. So if I

may, I will just refer to them as less-industrialized and more-industrialized.) Why are we interested in going into this Conference? I heard the answers here. I heard them from Mr. Belford. I heard them from Professor Somer. And heard them from our friend from Kenya, Mr. Owino-Okwero. These three gentlemen gave me the answers that I was looking for.

Mr. Belford said, let's be candid! Nobody is interested in giving something away for nothing. The United States government cannot compel the companies and the individuals in this country, who have acquired and developed technology at great personal expense to themselves and their investors, to give away that technology to others. They can only encourage, but they cannot compel, not under our free enterprise system. So there has to be a reason why, and one of the reasons is, there is benefit to be received by those in the United States who have that technology to transfer. It's a profitable venture for them to do it. It's a two-way street. I don't think there is anything wrong with that. I think this is a very proper way to do it, but I was very delighted, actually, in hearing Professor Somer make the same point. He made the point that the nations who need technology should not expect it to be given as a one-way street. It is not normal for people to work that way. I think he is being pragmatic. I believe it would be well for both sides of this transfer to keep that in mind. It is the best way to form a partnership that works.

My friend from Kenya made another point. If I may, it sounded like a plea, and I think it was a proper one. He said to the United States - "In doing what you are proposing to do or are involved in doing, you are doing something for humanity." And I am proud of that. And I think we all should be thinking that our country is doing this, not entirely for selfish reasons, although I do not deny them. They should be there. But also for humane reasons. Because the more we do good for others, the better we do good for us, all of us. Because if we uplift the nations of the world, I think everyone stands to benefit. I think that it is very proper of you to call that to our attention. And it should be one of the motivators in going to the Vienna conference, next year.

Dr. Fusfeld made a point repeatedly. I know Dr. Fusfeld, we started out in life together, back in our early government days, so I know how he thinks, and how he worries. He is very practical. He said over and over again, that those nations that are interested in acquiring technology should learn a lesson from the growth of corporations in the United States, and he might as well have said, in Germany, and in Japan, as well, because the lessons are identical. The same techniques that have been used to create our great corporations, wherever they are in the world, are the same techniques that should be employed in the countries that wish to develop themselves beyond their present state of industrialization. You can prove it in management, prove it in financing techniques. A lot of these things have been referred to over and over as "infrastructure". All of these things have to be developed in a very practical way. And you don't just have them happen. In other words, I think I heard Mr. Radway and some others say, one of the problems is, that some of the people in the nations that are looking for technology are thinking that they should demand it, that they can get it by changing their laws: they will acquire it, and they can use it. Frequently they are not ready to use it. They haven't prepared themselves properly. They need more help to prepare.

Now, I will cite you one of several experiences I have had, which I think might teach a lesson. Several years ago, I was a member of a group of the Licensing Executives Society that was invited to Mexico. We talked with a quasi-governmental organization, somewhat like our National Science Foundation. It was a time when President Echeverria was introducing new legislation regarding intellectual property transfer. We were being asked if we saw any problems. As this discussion was going on, I asked a question that I think sort of turned that conference upside down. I said, you know, if I were a Mexican, I would do exactly what you are doing. Except that I think you are doing it the wrong way. Because I think you are going to harm your country, rather than help. And of course they asked why? I said, well, you are going to impose restrictions, e.g., a 4% maximum royalty that was imposed, or proposed to be imposed; the fact

that you say we'll pay royalty, come down, leave your technology here, let our people use it, and then, that's all, we don't want you to just stay here. I heard that over and over again. I said, well, there is only one problem. If it is the General Electric Company, they've been in here so long and they have so much invested, it is not good business for them to leave. But many other investors, whether they are U.S., or from any other country, where their capital is limited for investment, they will choose to look to other countries rather than to invest in a country that follows policies such as you have proposed here. That is your danger.

So I think that that is the fear or the concern that I have, that in this course of transferring technology, I hope the countries that are looking for it and wish to receive it, and to whom we wish to give it, won't kill the goose that lays the golden eggs.

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C. Dr. Lee Kum Tatt (Chairman, Singapore Institute of Standards and Industrial Research):

When I look around me, I feel that I have been handicapped. Paraphrasing is not one of my specialties. So, since I do not always want to be a born loser, I will do something that I think I am good at: interpretation of silence. Sometime ago I met the top man of an aid-giving agency. He came to Asia, and he said, "You know, I thought everything was alright, how come this did not work out?" Then he said, "Yes, you know what happened!" I said, "It is not the English that you have to understand. It is the silence that you must learn to interpret." So today, paraphrasing of the English that has been spoken during these last two days, I will leave to my colleagues. I will try to interpret the silence that has not been spoken at this Seminar. And if my colleagues do not agree with me, please speak up if I interpret you wrongly.

First, I think it is obvious that we have the feeling that there is a ready keenness in the United States, as reflected by this Seminar and by the speech that was given to us last night by the Ambassador. So we never question the honest intention to do something for the world in the UN Conference in 1979. We believe that there is a mutual interest. We must also believe that we should do things, not on a one-way street, but to benefit both sides. But as our friend the lawyer said, "We have to be candid!" Now, that is not so easy for us to do. What is candid to one person is not candid to another. It may be a rudeness on their part. And we create a lot of misunderstanding that way.

Maybe, in the developing countries, the agents of change are the bureaucrats. In the developed societies like the United States, the agents of change are in the private sector. I think we recognize this distinction while we deal with those people. But our mentalities are so different, our motives are so different, and the rules by which we play our games are also very different. So when we say we are being candid, we mean different things. Maybe we have to learn to understand each other. And of course, in the developing countries, as our friend Mr. Radway says, we are not on an equal bargaining basis. And when one tries to be candid, you can give the impression that you are trying to force things down the other guy's throat. And that is not very healthy. Perhaps we should learn to do things in a more tactful way.

So I think from the developing countries' point of view, the points have been taken that we should as government, and as advisors to government, help the multinationals to achieve part of their objectives, and to create suitable climates for these people to come and work with us. We also recognize that many conflicts of interest, and the solution of these conflicts, depend very much on the priorities which each and everyone of us and our governments place on our goals. Whether it is on the social side, on the employment side, on the whatever side, we so decide at a particular point in time.

Another point that I would like to make is that I think there has been a lot of emphasis placed on manpower development. Technology transfer. I do feel that technology resides only in human beings, not in licenses, papers, and so on. So, we can only transfer

this technology from one human being to another. And if there are too many cultural differences, so that we cannot even understand each other, then I don't see how technology can be transferred. We can transfer physical facilities and whole plants, including the marketing and know-how. But once we have a misunderstanding, the plant that was set up in one month, can be dismantled in one week. Of course, that will cause a lot of disruption in the developing countries, and create a lot of problems for all of us. So I think that it is very important, that maybe we should not only have schools for NBS to teach metrology, but also the social sciences of understanding each other. Trying to interpret the other guy's silence. I think that maybe we should train people to negotiate.

I was involved quite some time ago, on a U.S. panel to form an International Industrialization Institute. One of the things that you had in mind was to train some people to negotiate - at least on the legal terms, which we can understand. I don't know what happened to that proposal. I had my misgivings. The name itself was bad. It was called I-cubed (ice-cube). And it remains in cold storage, and I think it is still in cold storage, is that right? But it would be something useful if we could train our lawyers to negotiate on equal terms.

Coming back to transfer of technology, the subject of QC, and so on, I think it is a very important subject, and we should place a lot of emphasis in getting something positive. I think many of the developing countries do feel tired of meetings and meetings to plan for things which will happen 25 years later. For developing countries, to keep alive -- to keep the so-called body and soul together -- we need something to live on and something to live for. When we send our scientists over to America, in an affluent society, there is no survival problem, they only go for things to live for. But when they come home, they have nothing to live on, they expect the other guys to produce it for them. So I think we have to have a proper balance of something to live on and something to live for. In most of our developing countries, I think the emphasis should be more on creating jobs in a quantitative aspect, to start off with, and after we have achieved a certain amount of success, maybe we should go to the qualitative aspect.

So that brings me to the last problem, the last question, What stand should the U.S. take? I don't think you should take a simple policy or one policy for all, because there are so many levels of development. And perhaps, an approach would be, how can the more developed help the less developed, and so on. And the gap between us will be smaller, and in this way if we can find some solution, or some understanding, I think that we will be in good health.

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D. Dr. Albert Small (Office of Science and Technology, U.S. Department of Commerce):

First of all, on behalf of the Department of Commerce, Assistant Secretary Baruch, and Deputy Assistant Secretary Wolek, I would like to thank and congratulate the personnel of the National Bureau of Standards who organized this Seminar, and the participants from this country and abroad who made it such a success. Our goal was to bring together people with hands-on experience in this field, and I think that this goal was impressively achieved.

I would like to leave the discussion of the details of our meeting and speak just to this one issue that the Department of Commerce considers of particular importance -- the achievement of sound, rapid industrialization by the Third and Fourth World countries, as a development tool. Let me preface this remark by saying that industrialization is complementary to progress in all other elements addressed to basic human needs -- health, education, housing, population, and the continuing progress in agricultural production. I believe that our representatives from the developing countries agree that full development cannot take place without the growth of industry. In some cases developing countries have already made impressive strides in the achievement of this goal. In other cases, industry is still in its embryonic stages.

I believe that there is an appreciation of the two types of industry needed for development: industry to meet basic consumer needs within the country, and industry that makes use of the country's labor and material resources to export and pay for the goods the country needs to import to continue on its development path. Each of these types of industry has its own infrastructure requirements, both physical and intellectual, and we are here dealing with some of the intellectual requirements. There is a need for technological absorptive capacity, so that a developing nation can select the technological resources that it needs from abroad and can adapt technologies to the most efficient satisfaction of its needs.

These ideas have already been elaborated in various papers and studies prepared for the Coordinator of the U.S. preparations for the UN Conference on Science and Technology for Development. I believe that our meeting has helped to pinpoint and clarify many of the issues related to the provision of a technological infrastructure for industrialization.

I want particularly to express my appreciation to a number of the participants who gave me their time in two special meetings, that we had to consider some ideas on industrial technology formulated here in the Department of Commerce. In these meetings, I substituted for Dr. Wolek. Very briefly summarized, the proposals to which I am referring, we call "technology for development". And they involve surveying a developing country's industrialization needs and goals, through the use of a joint team from the industrial and industrializing country, of a multi-disciplinary composition. Emphasis is placed on analyzing the industrial opportunities and problems, pin-pointing what Dr. Baruch calls the change agents, and then following through and implementing the team's recommendations, through various technology transfer arrangements.

I will not take your time to detail our discussions, but I can summarize them by saying that the participants expressed a genuine interest in novel approaches to promote industrial technology. They also added a number of highly useful thoughts of their own. They encouraged us to look into further opportunities for technology transfer involving the private sector, including joint ventures. They pointed up the problems, for example, in developing local sources for the components that multinational firms may be willing to assemble in developing countries. At the same time, they cautioned us that technology transfer -- and this is what Dr. Lee has just been talking about -- has its people-to-people elements. And any plan that does not recognize this and take it into account, can waste a precious opportunity.

We will commend these points to Ambassador Wilkowski and her staff, represented here. To the extent that these ideas may be reflected in U.S. participation in the UN Conference, we don't believe they will represent any attempt by the United States to represent itself as a sole source of the technology mentioned. Indeed, they are the ideas that can be shared by all the industrial countries in their desire to help the industrializing countries. And just as Dr. Baruch has stated, that we are all at one stage or another of industrialization, so many of the developing countries are also highly industrialized by now, and they may wish to join the United States, Western Europe, and Japan in offering their assistance to other countries, that still have further to go along the path to full industrialization.

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E. Mr. James A. Stromayer (Deputy U.S. Coordinator for the UN Conference on Science and Technology for Development):

I would like to start out by renewing the thanks that I am sure Jean Wilkowski expressed last evening to all of those responsible for this Seminar, which I think is going to be very useful and productive. I must say, I feel somewhat disadvantaged in trying to sum up, because I missed yesterday's session, but just being here today, I think I heard so much said that was very wise, that I am sure that I had been here two days, I would feel even stronger about it.

On the other hand, I want to reiterate quickly that the more I listen to people that do know something about this subject -- economic development -- the humbler I become, and the more I feel and appreciate the complexities of the development process and the kinds of efforts that are required if we are to make it work better. I might say that I was especially impressed by the two presentations by Dr. Lee that I was able to listen to, and let me just give a few personal reflections on some of the things he suggested. It seems to me he suggested at least 36 points that could occupy us in long sessions in a seminar, for many days to go, but two or three of the things he said made a specially strong impression upon me.

First of all, let me refer to this phrase that we all use so knowingly, "transfer of technology". I have felt for a long time that there is something wrong with it, but have never been able to identify what. However, what I have heard here today increases my confidence that there is something wrong with it, and gives a different dimension to it. First, I think the notion itself implies some sort of simplistic transfer of some sort of device or knowledge from Point A to Point B, and that it works at Point B somewhat the same as it would at Point A. This, I think we all agree, is terribly simplistic and doesn't even begin to suggest the complexities of the subject.

But perhaps more important is something that Dr. Lee said in ticking off the various characteristics of the situation in Singapore that struck me. He said that the philosophy and the attitudes of the people are of great importance in the development process. And this, it seems to me, is key to our considerations, and probably key also to some of the various serious and grave mistakes we have made in the past. The notion of technology transfer suggests a process going, in the old jargon, from donor to recipient. And this is a basic misconception of the process, at least if the model that Dr. Lee presented to us is correct. And that is, that it is a basic requirement of each society itself to define what it is and what it wishes to become, and what kind of society it should be in the future. And this is the notion of philosophy and attitude which he stressed.

The second point is that once a society has decided what it wishes to become, it has to decide how to go about it. And this involves the question of choice of technology. So that these are very, very heavy requirements that are on the shoulders of the developing countries, something that we in the developed world were rather slow in learning. In the olden days I think we used to think that we could just transfer these things to the developing countries, they would adopt them, and somehow develop along the same lines that we have. But in fact, the process *starts* there, as it were, defining what sort of society the developing countries wish to become, then choosing the technologies that are best suited to do that.

And here I get to a point raised by Dr. Qurashi, this morning, when he said that the stress we place on self-reliance relates very much to the selection of technology. And many developing countries at this stage of development simply do not have the people -- the trained scientists, technologists, engineers, technicians -- who can competently and rationally make these choices. And that it is these kinds of people that most of the developing countries need more of.

Well, again, this suggests something to us. That the developing countries, having decided what they wish to become, and the kinds of choices that they want to make in becoming that sort of society, could use some assistance, to be defined by them, in developing human resources and institutions that are better able to make these choices in a much more self-reliant way than they can now. This suggests to me, at least, something that ought to be fundamental to our own preparations, and that is, that we ought to try to organize ourselves to be able to provide those kinds of educational and training services, perhaps more efficiently and more effectively than we have up to now.

Now this relates, too, to the role of an institution like the National Bureau of Standards, which as an American, I view as one of our genuinely excellent institutions. When we think of the NBS we think of high

quality work. And, my hope is, that to the extent that metrology, quality control, standardization -- which are sort of the hallmarks of this institution -- to the extent that the developing countries themselves feel the need for institutions of this kind and expertise of this kind, that we in the United States will be able to respond, again, perhaps better than we have up to now. In some of the discussions that I have had with Ed Brady, my impression is that there is a limitation on the amount of resources that NBS can devote to this activity, and it would seem to me that one of the things that ought to come out of this Seminar and work into our own preparations for the Conference would be that if there is indeed a greater demand for this kind of service and this kind of institution, the U.S. Government ought to give very serious consideration to having sufficient resources at hand to provide these services.

Let me just wind up with three or four other remarks. What I have tried to say is that the developing countries have to define for themselves what their needs are, and we have to see whether we can respond. And not vice-versa. The second thing is, it seems to me they have identified to us certain needs in human and institutional development, to which we can relate, and hopefully respond better than we have in the past.

Now, in terms of the state that we have reached in our own preparations, I would just tick off sort of three general orientations of policy, at the risk of repeating to some extent what Ambassador Wilkowski said last evening. The first conclusion we have come to in the preparatory process thus far, anyway, is that it would seem that the overwhelming need, the overwhelming demands, even, of the developing world, to the extent to which you can generalize about it, is that they need and would like help in developing their own indigenous capabilities in science and technology, and in the whole range of activities that relate to science and technology, right from the creation of technology to the development of products to the marketing of products, and to managerial expertise, generally. It is in this area, that we believe the developing countries are saying, this is the area in which you can help us. And we would like to organize ourselves better to do that.

The second point is, as I am sure has been raised here yesterday -- I heard it once or twice today -- there is the President's proposal for a Foundation for International Technological Cooperation, which would try to organize and focus U.S. institutional resources, including those from the private sector, the Government, the domestic agencies, the foundations, the universities, the research labs, in a much more effective and efficient way than we have done in the past, and it is our very strong hope that that institution can be in being before the Conference.

Finally, I would like to get to the point of mutual benefit, that many have stressed here earlier, and that is, that we in the United States recognize very much that there are a whole host of global problems, in the fields of energy, food, health, education, and so on, which are problems that are no longer susceptible of national solutions, they are problems which require international solutions, they are problems which require international cooperation. I think that we have got to get the word across to the people of the United States perhaps better than we have up to now, that these kinds of cooperative activities with developing countries are not a one-way street, but indeed will yield benefits to us on our own specific problems. We approach the conference in that spirit, and I just think we have to do a better job of convincing the American public that that is true.

Dr. Lee:

I would like to say, Thank You, to you and your colleagues in NBS, who have organized this excellent seminar, and the people from AID and all our American friends who have taken time off to be with us and to share their views with us on how to build the infrastructures and develop manpower for this transfer of technology, to input into next year's Conference of the UN. I think I am speaking on behalf of my colleagues from the various countries, that we have enjoyed ourselves here, and I would like to say Thank You for all the wonderful arrangements you have made for us. Thank you very much.

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Dr. Brady:

Well, let me thank you, too, Dr. Lee, for those remarks. Really, there are so many people here that deserve thanks for the contributions that they have made to these two days, that it really is impossible to list people by name, or even by organization, such as AID, the U.S. Coordinator's Office, the Office of the Assistant Secretary for Science and Technology, but specially I think we ought to thank those people, such as Dr. Lee himself, Dr. Choi, Professor Somer, Mr. Coria, Dr. Qurashi, and Dr. Alberto, who has already had to leave to return to Brazil, who came especially for these two days -- people who have come long distances to give us the benefit of their experience and their words on these important things that we have been talking about.

APPENDIX 1. PROGRAM

NBS/AID UNCSTD SEMINAR

THE TECHNOLOGICAL KNOWLEDGE BASE FOR INDUSTRIALIZING COUNTRIES

October 16-17, 1978

National Bureau of Standards
Gaithersburg, Maryland

MONDAY, OCTOBER 16, 1978

9:15-10:30 I. KEYNOTE SESSION - Chairman: Dr. Ernest Ambler, Director, National Bureau of Standards

1. The Objectives of the Seminar - Dr. Jordan J. Baruch, Assistant Secretary of Commerce for Science and Technology

2. Expanding Horizons: Technological Knowledge for Industrial Takeoff - Dr. Herbert I. Fusfeld, Director for Science and Technology Policy, Graduate School of Public Administration, New York University, New York City

10:45-12:45 II. MEASUREMENT CAPABILITIES AND SERVICES REQUIRED BY TECHNOLOGICAL INDUSTRY - Chairman: Mr. Hamilton Herman, Industrial Consultant, Potomac, Maryland

1. Survey of Measurement Needs of an Industrializing Country - Dr. Jong Wan Choi, Administrator, Industrial Advancement Administration, Seoul, Republic of Korea

2. Experience of a Major U.S. Firm in a Newly Industrializing Country - Mr. Rafael Coria, General Manager, Radiocommunication FM Operation, General Electric de Mexico, Mexico City, Mexico

3. Short Contributions:

Mr. Horacio F. Mazza, Instituto Nacional de Tecnologia Industrial, Buenos Aires, Argentina

Ir. Gandhi, Yayasan Dana Normalisasi Indonesia, Bandung, Indonesia

Dr. Kailash Chandra, National Physical Laboratory, New Delhi, India

1:45-3:45 III. NATIONAL AND INTERNATIONAL STANDARDS THAT MUST BE SATISFIED BY INDUSTRIALIZING NATIONS - Chairman: Dr. Khaled Y. Al-Khalaf, Director General, Saudi Arabian Standards Organization, Riyadh, Saudi Arabia

1. Meeting the Standards Requirements of Trading Partners - Mr. Abdulla Fadlalla, Acting Secretary General, Arab Organization for Standardization and Metrology, Cairo, Egypt

2. The International Standards Picture - Mr. Richard B. Belford, Technical Director, Industrial Fasteners Institute, Cleveland, Ohio

3. Short Contributions:

Mrs. Lorna Lawrence, Guyana National Bureau of Standards, Georgetown, Guyana

Mr. Remon Halteh, Directorate of Standards, Amman, Jordan

Mr. J. E. Owino-Okwero, Kenya Bureau of Standards, Nairobi, Kenya

Mr. Thiagarajan Rajaraman, Tanzania Bureau of Standards
Dar es Salaam, Tanzania

Dr. Robert W. Middleton, International Organization for
Standardization, Geneva, Switzerland

4:00-5:00 IV. WORKSHOP - MANAGERIAL RESPONSIBILITIES AND TECHNICAL KNOWLEDGE
- Chairman: Dr. Robert W. Middleton, Assistant Secretary General,
International Organization for Standardization, Geneva, Switzerland

1. Management of the Acquisition of Technical Knowledge
- Professor Tarik G. Somer, Assistant President, Middle East
Technical University, Ankara, Turkey

2. Short Contribution:

Mr. Ridha Bouhalila, Laboratoire Central, Tunis, Tunisia

5:30 RECEPTION

6:30 DINNER - Speaker - Ambassador Jean Wilkowski, U.S. Coordinator for the United
Nations Conference on Science and Technology for
Development, State Department, Washington, D.C.

TUESDAY, OCTOBER 17, 1978

9:00-11:00 V. KNOWLEDGE REQUIRED FOR INDUSTRIAL QUALITY CONTROL
- Chairman: C. B. Butts, Supervisor, Equipment Engineering, Detroit
Diesel Allsion, General Motors Corporation, Indianapolis, Indiana

1. Establishing a Quality Control System in an Industrializing Country
- Professor Kenneth S. Stephens, Georgia Institute of Technology,
Atlanta, Georgia

2. High Technology Quality Control in a Newly Industrializing Society
- Dr. Lee Kum Tatt, Chairman, Singapore Institute of Standards and
Industrial Research, Singapore

3. Short Contributions:

Dr. Jose L. Tudor, Barbados National Standards Institution,
St. Michael, Barbados

Mr. Dong Ho Kim, National Industrial Research Institute,
Seoul, Korea

Admiral Jose de Castro Waeny, Instituto de Pesquisas Tecnologicas,
Sao Paulo, Brazil

Mr. Abdel G. Suliman, Department of Standardization and Quality
Control, Khartoum, Sudan

11:15-12:15 VI. WORKSHOP - MANAGERIAL RESPONSIBILITIES AND TECHNICAL KNOWLEDGE
- Chairman: Miss Winifred Armstrong, Vice President, International
Management Development Institute, New York City, New York

1. Management of the Deployment of Technical Knowledge in Pakistan
- Dr. M. M. Qurashi, Director General, Appropriate Technology
Development Organization, Islamabad, Pakistan

1:15-3:15 VII. KNOWLEDGE REQUIRED TO ENABLE A COUNTRY TO ACQUIRE COMMERCIAL INDUSTRIAL TECHNOLOGY - Chairman: Mr. Albert R. Baron, Interregional Adviser, Development Planning, Department of Technical Cooperation for Development, United Nations, New York City, New York

1. Experience of a Country with an Intermediate Economy
   - Dr. Alberto Pereira de Castro, Superintendent, Instituto de Pesquisas Tecnologicas, Sao Paulo, Brazil

2. The Role of Licensing Negotiators
   - Mr. Robert J. Radway, Attorney, New York City, New York

3. Short Contributions:

   Dr. James A. Slater, U.S. Department of the Interior, Washington, D.C.

   Mr. James Gudaitis, Center for Concern, Washington, D.C.

   Mr. Ridha Bouhalila, Laboratoire Central, Tunis, Tunisia

   Dr. Khaled Y. Al-Khalaf, Saudi Arabian Standards Organization, Riyadh, Saudi Arabia

3:30-4:30 VIII. SYNTHESIS AND PROJECTION - GUIDANCE FOR THE U.S. IN THE UNITED NATIONS CONFERENCE ON SCIENCE AND TECHNOLOGY FOR DEVELOPMENT, AND BEYOND - Chairman: Dr. Edward L. Brady, NBS Associate Director for International Affairs

Dr. Howard I. Forman, Office of Product Standards, U.S. Department of Commerce

Dr. Lee Kum Tatt, Singapore Institute of Standards and Industrial Research

Dr. Albert Small, Office of the Assistant Secretary for Science and Technology, U.S. Department of Commerce

Mr. James A. Stromayer, Deputy U.S. Coordinator for the UN Conference on Science and Technology for Development

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16. ABSTRACT *(A 200-word or less factual summary of most significant information. If document includes a significant bibliography or literature survey, mention it here.)*

The National Bureau of Standards held a two-day seminar to explore needs for the technological knowledge base for industrializing countries and procedures for acquiring and applying it, in the areas of measurement capabilities and services required by technological industry, national and international standards that must be satisfied by industrializing nations, knowledge required for industrial quality control, knowledge required to enable a country to acquire commercial industrial technology, and managerial responsibilities and technical knowledge. The Proceedings are background material for preparation of U.S. positions at the UN Conference on Science and Technology for Development in Vienna, August 1979. Cosponsors included the Office of Science and Technology, Dept. of Commerce; U.S. Coordinator for the UN Conference, Dept. of State; and the Agency for International Development. The 97 registrants came from Argentina, Barbados, Brazil, Egypt, Guyana, India, Indonesia, Jordan, Kenya, Korea, Lesotho, Mexico, Pakistan, Panama, Philippines, Saudi Arabia, Singapore, South Africa, Sudan, Switzerland, Taiwan, Tanzania, Tunisia, Turkey, and many public and private organizations in the U.S. Key words used to summarize the conclusions were: local realities; industrialization; import, adapt, and innovate; complexity; technology assessment; indigenous capabilities; metrology, standardization, and quality control; survey projects; instrumentation; international standardization; existing plant; access to industrial technology; management; organizational climate; the human resource; the UN. All are important and need attention/support.

17. KEY WORDS *(six to twelve entries; alphabetical order; capitalize only the first letter of the first key word unless a proper name; separated by semicolons)*

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