NBSIR 73-185

Standardization and Measurement Services in Korea

A Report of a National Bureau of Standards/Agency for International Development Survey Conducted June 19–30, 1972

A Report of Survey Conducted jointly by the National Bureau of Standards and the Agency for International Development.

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DEPARTMENT OF COMMERCE
NAL BUREAU OF STANDARDS

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U. S. DEPARTMENT OF COMMERCE, Frederick B. Dent, Secretary

NATIONAL BUREAU OF STANDARDS, Richard W. Roberts, Director

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Explanatory Note

This Report has been available in draft for almost one year prior to publication. Progress and further planning by the Korean Government meanwhile has been vigorous so that some remarks in this Report must be regarded as for the record only. The economic development of Korea has taken an even more favorable turn than is described in the Report. The new organization proposed has been formed but its name is not Office of Industrial Promotion, but Industrial Advancement Administration. The organizational structure of this Administration differs in some important details from that proposed in this Report. These changes are intended as further improvements on the earlier proposals described in this Report.

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I. INTRODUCTION

Leaders of every country strive to achieve a higher standard for their people; better education, sounder health, and an improved quality of life. In the world community of nations these goals have hitherto been unattainable in an economy based solely on agriculture and sale of unprocessed natural resources. Processed agricultural and manufactured products are also needed which in turn require the support of standards, calibration, measurement and testing services. These services have been important features of all highly industrialized countries and have accompanied the industrialization process of rapidly developing countries. Such activities may be critical elements in developing economies for control of manufacturing processes, quality control of products, encouragement of exports, and the transfer of technology from abroad. The availability and level of these services in Korea was the concern of this survey.

The National Bureau of Standards and the Agency for International Development in Washington cooperate in a program of consultation on relevant infrastructure services with three developing countries designated as target countries. This program was planned as a modest effort to test on a worldwide basis the effectiveness of NBS collaboration in the industrialization endeavors of these countries. It was decided that for best results, this test program should be confined to a few carefully selected and widely separated areas of the world in which effectiveness could be evaluated on the basis of essentially experimental activities. Basic criteria for target countries were the following:

a. Each target country must be a developing nation currently on the AID list.

b. Each target country must be willing to invest some of its own resources in the effort.

c. There must be reasonable expectation of internal stability in each target country.

The developing countries which welcomed this opportunity and are now included as target countries are Ecuador, Korea, and Turkey.

A. OBJECTIVES OF THE SURVEY

The surveys were to establish a set of practical recommendations that would promote the implementation and development of useful standardization and measurement services in the target countries. To provide a basis for the recommendations, the survey team planned to

collect data in a number of critical subject areas. Subjects of major interest were the following:

a. The extent to which government officials, industry leaders, and workers were aware of the need for standards and their importance to an industrializing economy.

b. The present state of utilization of standards in the country in selected spheres of economic importance.

c. Research and testing facilities available in industry, government, and the universities.

d. Quality control systems in industry, and procedures adopted for exports.

e. Facilities available within the industrial complex and other organizations for calibration of instruments and testing equipment.

f. Institutions, government departments, and other organizations engaged in the preparation of standards in the country.

g. Special procedures for evaluation and quality control required to maintain the competitiveness of exported products and raw materials.

h. Laws currently in force affecting standardization and quality control for import and export of goods.

i. Laws currently in force with regard to weights and measures.

j. Facilities available within the country for training of: (1) standards personnel, and (2) quality control personnel.

B. OPERATING MODE

The surveys were to be under the direction of an outstanding leader of the target country interested in standardization and measurement. He would have the responsibility for selection of specific survey goals, for the development of a program and for the guidance of follow-up programs. Each survey was to last about two weeks in country. Team members were to come from NBS and the other target countries. The host country would provide other team members and assure that typical relevant contacts would be made with government authorities, industry, universities and the public.

C. PREPARATION FOR THE SURVEYS

Although less developed countries may differ significantly from each other in their resources and their individual aspirations with respect to industrial development, many of the problems they face in establishing an effective infrastructure of measurement technology and standardization for production and quality control are similar. As a result standardization experts in most of these countries are eager to share experiences and learn from each other. This survey was organized with the intention of optimizing the potential benefits of this exchange.

Accordingly the three developing countries participating in the program (Ecuador, Turkey, and Korea) were invited to send representatives to a week-long intensive standardization workshop held at the National Bureau of Standards in Gaithersburg, Maryland. The Workshop described in NBS Report 10901 was designed not only to describe the services provided by NBS to the technical and scientific community, but also to allow for discussions and presentations of different institutional and organizational approaches to providing these services in other countries. The aspects stressed in the Workshop included:

a. Maintenance of national standards of measurement compatible with the Système International (SI).

b. Field surveillance of weights and measures.

c. Procedures for the development of standards (including safety, building codes, and consumer protection).

d. Inspection and quality control of production (sampling, tolerance, control charts).

The Workshop was held at the National Bureau of Standards from April 21 - April 30, 1972. Attending, besides the U.S. representatives,were:

Ing. Raul Estrada	Technical Director of the Instituto Ecuatoriano de Normalizacion
Mr. Young Pyo Hong	Senior Mechanical Engineer Central Bureau of Weights and Measures Ministry of Commerce and Industry Seoul, Korea

Mr. Velid Isfendiyar	Secretary General Turkish Standards Institute Ankara, Turkey
Mr. Byong Sik Jeon	Chief of Specialization Division Korean Bureau of Standards Ministry of Commerce and Industry Seoul, Korea
Mr. Luis Urresta	Engineer, Instituto Ecuatoriano de Normalizacion Quito, Ecuador
Mr. M. Fuat Yucesoy	Senior Mechanical Engineer Turkish Standards Institute Ankara, Turkey

Immediately following the Workshop the first survey was conducted of Ecuador's standardization and measurement services (NBS Report 10881).

D. KOREAN SURVEY TEAM AND STAFF

The entire Korean survey took place under the joint personal sponsorship of the Hon. Dr. Hyung Sup Choi, Minister of Science and Technology, and the Hon. Mr. Nak Sun Lee, Minister of Commerce and Industry. It was under the direction of Dr. Sang Keun Chun, at that time Director of the National Science Museum.

With the exception of Mr. Isfendiyar and Mr. Urresta, all of the visitors at the Workshop participated in the Korean survey. The NBS representatives were:

Dr. Thomas D. Coyle	Chief Inorganic Chemistry Section Inorganic Materials Division Institute of Materials Research
Dr. Ronald K. Eby	Chief Polymers Division Institute of Materials Research
Mr. H. Steffen Peiser	Chief Office of International Relations

The Korean Mission of USAID was represented by Dr. Newman A. Hall, the Science Advisor, himself expert in standards and measurement science

and available as a continuing link between non-Korean Team members and representatives of the Korean government.

Well before the arrival of the NBS/AID contingent, the Korean Government laid thorough and detailed plans. They appointed the following Korean team members, all acknowledged Korean leaders in the field of standardization and measurement:

Dr. Sang Keun Chun	Director General of Survey, Director National Science Museum
Mr. Byung Kil Lee	Director Korean Bureau of Standards (KBS) Ministry of Commerce and Industries (MCI)
Mr. Chong Hak Kim	Director Bureau of Weights and Measures, BWM, MCI
Mr. In Bok Chung	Director The First Department National Industrial Research Institute (NIRI) MCI
Mr. Buk Sun Lee	Director Office of Overall Planning Office of Research Coordination Ministry of Science and Technology (MOST)
Dr. Jae H. Yang	Deputy Director Korea Institute of Science and Technology (KIST)
General Chun Hwa Lee	Director Fine Instrument Center (FIC)

The importance and urgency attached by the Korean Government to this Survey is further illustrated by the appointment of the following support secretariat:

Mr. Byung Sik Chun	Chief, Specification Division KBS, MCI
Mr. Young Pyo Hong	Senior Technical Staff Inspection Division, BWM,MCI
Mr. Hai Sool Chin	Senior Staff, Office of Research Coordination , MOST

Mr. Chong Chul Kyung	Senior Staff, Office of Research Coordination, MOST
Mr. Chung Joe Meng	Senior Research Staff, NIRI, MCI
Mr. Young Suk Yoon	Division Chief, FIC
Mr. Tae Yoon Um	Senior Staff, KIST

The Korean team had done extensive preparative work. They had gathered briefing papers for the NBS/AID contingent, rushed necessary translations, and held discussion resulting in strongly supported tentative conclusions.

E. PREVIOUS STUDIES ON KOREAN STANDARDIZATION, QUALITY CONTROL AND MEASUREMENT SERVICES

Two NBS team members (Eby and Peiser) had taken part in a previous AID-supported study in 1967 (NBS Report 9811). The recommendations made then and the underlying logic are similar to the outline of the present survey report. In the intervening time, apparently neither USAID nor the Republic of Korea was willing to recommend high priority to implementation. Now, however, both the Republic of Korea and USAID seem convinced that urgent action is needed.

Mr. M. C. Probine, Director of the New Zealand Standards Laboratory, at the invitation of UNESCO, in 1970, carried out "a survey of the facilities for precision measurements in South East Asia." Within its field this survey is detailed and penetrating. In the conclusions relating to Korea, the following remarks are worth quoting here: "It is therefore suggested that early consideration be given to setting up a national standardizing laboratory with responsibility for precision measurement in all fields at the national level . . . if Korea is to achieve its industrial development targets it will need to be done sooner or later . . ." The present survey report concludes that the time has now come.

F. THE SURVEY TEAM'S ITINERARY IN KOREA

Sunday, June 18

Peiser, Coyle, Eby and Estrada arrived Seoul, late evening.

Monday, June 19

NBS Team briefed by Dr. Newman Hall, Physical Science Advisor to US AID Mission in Korea.

Team received by Dr. Choi, Hyung Sup, Minister of Science and Technology

Team received by Mr. Lee, Nak Sun, Minister of Commerce and Industry

First meeting of entire Korean Survey Team, including NBS team, their Korean counterparts, and Korean support staff (secretariat). Background documents prepared in advance of NBS team's arrival were presented, itinerary discussed, and scope of service of the NBS team, as viewed from the Korean side, was outlined.

Mr. Yucesoy arrived in Seoul, having been delayed en route.

Tuesday, June 20

Visit to Korean Bureau of Standards

Visit to Bureau of Measurement (formerly Bureau of Weights and Measures)

Visit to Electricity Division of the Communication Research Institute of the Ministry of Power and Communications.

Wednesday, June 21

Team received by Mr. Michael H. B. Adler, USAID Mission Director

Visit to Korean Institute of Science and Technology (KIST)

Peiser presented talk on NBS Mission and Program Structure at KIST

Visit to National Industrial Research Institue (NIRI)

Evening: Peiser, Coyle, Eby were dinner guests of Professors Yu and Noh, Inha University, and Professor Paik, of Kyung Hee University.

Thursday, June 21

Visit to Fine Instruments Center.

Visit to Kia Industrial Co., Ltd., manufacturers of steel pipe, bicycles, trucks, etc.

Visit to Hanyung Industrial Co., Ltd., manufacturers of large power transformers and electric motors.

Evening: The NBS team was entertained at a dinner party hosted by the Vice Minister of Commerce and Industry, Mr. Kim, Yong Hwan.

Friday, June 23

Team spent day at Ministry Building in discussion of details of report. Preliminary drafting of first section of report.

Saturday, June 24

Day spent at Ministry. Draft of first section of report dealing with definition of problem areas in Korean standards and measurement services accepted by team.

Eby departed for U.S.

Sunday, June 25

Peiser continued work on report. Coyle, Estrada, and Yucesoy departed by car for Kyung-ju and Pusan, accompanied Mr. Jeon, Byongsik.

Monday, June 26

Peiser in Seoul to continue work on report. The remainder of the NBS team spent the day in Pusan, in the following visits:

Pusan-Kyungnam Industrial Research Institute (Provincial laboratory with primary responsibilities in export inspection)

Korea Shipbuilding and Engineering Corporation

Pusan Custom House Laboratory

Vinyl Calendering Division, Lucky Chemical Co., Ltd.

The group visiting Pusan returned to Seoul, arriving early Tuesday.

Tuesday, June 27

Team spent day at Ministry in discussions of draft report, particularly on functions and organization of proposed Office for Industrial Promotion.

Wednesday, June 28

Team spent the morning at US Embassy completing draft report.

Draft report presented to Director Chun and Korean team. Korean team and translators prepared Korean version of report.

Thursday, June 29

NBS team attended briefing on report presented by Dr. Chun to Ministers Choi and Lee.

Friday, June 30

Visit to Korea University, Seoul, by Peiser and Estrada

Final discussion by Peiser and Coyle with Dr. Chun.

Yucesoy departed Seoul.

Saturday, July 1

Remainder of NBS team departed Seoul.

II. KOREA, ITS ECONOMY AND KEY INSTITUTIONS RELEVANT TO THE SURVEY

With a population of about 32 million, three large cities (Seoul, Pusan, and Inchon) and an area of about 100,000 km^2 (23% is farm land with rice as principal product) Korea by 1971 had attained a GNP of about $8 billion or a per capita GNP of $253 per annum. Korea's imports at about $2.2 billion were double its exports but present trends show a marked improvement. Almost 50% of the population works in agriculture. Only a little more than the 15% of the working population work in mining (chiefly coal and tungsten) and manufacturing (principally iron and steel, cement, fertilizer, fibers, ships, autos, and electronic products). The growth rate of mining and manufacturing averages about 18%, whereas that of agriculture is less than 4% per year. Exports are growing at about 39%: imports by 25% per year. Korea can boast of rapidly improving social services, transportation, power, and communications systems. Integrated steel and petro-chemical industries are major current projects helping Korea toward self-reliance and sound balanced growth. Korea's development has rightly been called a miracle. It is no less so when one remembers that Korea finds itself compelled to devote much national effort on its defense posture. The determination and character of the Korean people gives substance to the hope of major economic achievements in the years ahead. The third Korean five-year plan, 1972-1976, is the blueprint for this progress. In science and technology the Korea Scientific and Technological Information Center (KORSTIC) and the Korea Advanced Institute of Science (KAIS) are given a major place. The plan makes no mention of, but is flexible enough to allow for, a new Office to be added which shall tentatively be called Office of Industrial Promotion (OIP) in this report. It is to function at high governmental level with a mission to be recommended in this survey report. A concept similar to OIP had appeared prior to the arrival of the NBS Team and served as a framework for much of the investigational program carried out during the survey.

Under an Industrial Standardization Law, Korea presently has a Korean Bureau of Standards (KBS) within the Ministry of Commerce and Industry (MCI). This Bureau is responsible for industrial standardization and the operation of a product quality marking scheme (KS). KBS is the national organization adhering to the International Organization for Standardization (ISO) and the Electro-Technical Commission (IEC). It is supported by an advisory body, the Council for Industrial Standardization, and a private Korean Standards Association (KSA). There are 17 divisional standards committees operating within KBS supervising the work of many technical committees.

The National Industrial Research Institute (NIRI) (also within MCI) advises industry, tests products, supervises the export testing by twenty laboratories specifically designated by product, incorporates the Masan Procelain Laboratory, and has considerable in-

house facilities, especially in chemical analytic techniques. NIRI also has information and training functions. Its applied industrial research has been questioned for fear of overlap with KIST. However, NIRI or a successor Governmental laboratory, should probably continue to provide short-term problem-solving type consultation which is very useful but of little interest to KIST. NIRI has had for the past five years a sistership relationship with the US/NBS. However, this formal relationship has had little effect on actual technical contact, despite high level attention from the annual MCI-US Department of Commerce ministerial meetings.

The administration of the Weights and Measures Law is presently the responsibility of the Bureau of Weights and Measures (BWM). It also is under MCI and has a large new building in an advanced stage of construction at the Yongdeungpo Export Industrial Estate. Unfortunately, further expansion at this site is no longer possible.

The Korea Institute of Science and Technology (KIST) is an independent applied research, contract-oriented, not-for-profit laboratory with outstanding facilities and staff. It houses the physical standards donated to the ROK by the late President Lyndon B. Johnson. These standards are of the same type as those provided to the States (of the U.S.A.) for the regulation of weights and measures in retail markets. Of the three KIST specialists trained by NBS in the use of these standards, only one is currently still employed by KIST.

The Fine Instrument Center (FIC), another independent institution not incorporated within a government department, exists under an agreement with the UN and may in the future be constituted as another not-for-profit private organization. FIC is also a laboratory of excellence. It maintains, repairs, tests, and calibrates instruments; advises and certifies manufacturers; promotes the Korean instrument industry; operates successful technical training courses; offers extensive calibration services; and disseminates technical and market research information. No future plan for Korean measurement services should fail to use and build upon these facilities within KIST and FIC.

Korea has other government agencies not previously mentioned concerned with standardization including:

1. Livestock Experiment Station

2. Agricultural Material Inspection Station

3. Provincial Sanitary Testing Laboratories

4. Electrical Communication Research Institute

5. Radio Research Institute

6. Radiation Research Institute for Agriculture

7. Radiological Research Institute

8. Atomic Research Institute

In addition, there are many other government and private agencies not listed here which conduct testing and inspection of goods and products for use under various specific laws. Examples are:

1. Vehicle Inspection Station under the Vehicle Transportation Law

2. Ships and Vessels Inspection under the Ships and Vessels Safety Management Law

3. Korea Lubricating Oil Testing and Inspection Station

Export goods inspection agencies designated by the government are the following government organizations:

1. National Industrial Research Institute (NIRI) (Export Goods Inspection Dept.)

2. Kyungbuk Provincial Industrial Research Institute

3. Kyungnam Provincial Industrial Research Institute

4. Chungnam Provincial Industrial Research Institute

5. Chungpuk Provincial Industrial Research Institute

6. National Inspection Station for Agricultural Products

7. National Inspection Station for Fishery Products

8. National Seoul Silk Inspection Station

9. Animal Quarantine Station

10. Forest Experiment Station

11. National Institute of Health

12. Technical Research Laboratory, Office of National Tax

The following are examples of private organizations with important standardization programs:

1. Korea Textile Testing and Inspection Station

2. Daehan Cloth Testing and Inspection Station

3. Daehan Knit Goods Testing and Inspection Station

4. Daehan Chemical Products Testing and Inspection Station

5. Daehan Mineral Products Testing and Inspection Station

6. Art and Craft Products Testing Station

7. Korea Hair Products Testing and Inspection Station

Several provincial laboratories show signs of being capable of receiving wider centrally coordinated responsibilities.

A largely untapped resource of standardization and measurement services lies in the numerous technical universities and colleges of Korea.

During the survey it was not possible to study each of the above listed institutions, so no appraisal of their operations or effectiveness is intended in this report.

III. NATIONAL INSTITUTIONS FOR STANDARDS, MEASUREMENT, AND QUALITY CONTROL -- THE POSITION OF THE PROPOSED OFFICE OF INDUSTRIAL PROMOTION

All industrialized nations have a national capability in standards, measurements, and quality control. The nations that have advanced most rapidly usually possess large and sophisticated services in these areas. Structure, size, and scope of such institutions vary greatly and the relationships and responsibilities for supporting and controlling these institutions may take diverse forms. In general, however, they fall into one of the following broad categories.

1. One or more governmental institutions responsible to a minister and financed from the state budget. This category is found in countries with centrally planned economies and in some other countries, e.g., Ireland, Mexico, Soviet Union, Burma, Ceylon, Greece, Iran, Japan and Ecuador.

2. One or more private autonomous organizations taking the form of a foundation or association. Some of the older national standardizing bodies have this type of structure and operate without

any official support or control as in the Federal Republic of Germany, Switzerland, Turkey, but in most cases a government subsidy provides a significant part of their revenue. In Argentina such subvention is quite indirect. It is operative through a levy on development loans to industry payable direct to the Institute for Industrial Technology. Government influence over some such operations appears to be growing but stops short of participating in their management.

3. One or more jointly managed institutions, also autonomous, in which both government and private interests participate. Management is shared to a degree depending on the country's industrial development and of relative government interest, as in India and the U.S. This category has been adopted by a number of developing countries and there have been instances of changing over from the first type (government controlled) to this form (New Zealand and Pakistan).

Regardless of the organization structure involved, the common objectives of relevant national bodies can be described as follows:

1. To prepare standards and promote their general adoption at the national level with the cooperation of all the interests concerned for the purpose of improving that country's industry and agriculture, and facilitating its domestic and foreign trade. The interests would include organizations, industry, government departments, trade, and technical associations, etc., whose activities may or will be affected by the establishment of a standard;

2. To make continual checks to ensure that the national standards formulated under objective (1) are abreast of the latest scientific and technical developments; and to amend, revise, or withdraw them so as to maintain them at the state-of-the-art;

3. To promote standardization as a technical activity and an integral yet distinct function of management (this includes the promotion of company standardization, quality control, simplification, and allied techniques in industry and commerce);

4. To serve as the national channel for exchange of information and for cooperation in the coordination of standardization work with other countries, including work at the regional and the international levels;

5. To serve as the national center of and clearinghouse for all information on subjects in the field of standardization.

In addition to the preceding, the national body may also be delegated:

6. To function as a metrology center and repository of fundamental physical standards;

7. To undertake tests for industry and issue certificates of compliance with standards;

8. To implement national standards through administering a national certification marks program or the inspection of goods.

9. To act as technical focal point for the governmental management of natural resources, the environment, communication etc.

10. Technological advice and consultation, and development of new technology.

Resources and responsibilities for standards, measurement, and quality control do not necessarily have to be assigned to a single organization in each country. In fact, numerous alternatives for splitting and allocating these functions have been selected and implemented in nations at varying stages of development. Numerous authorities have concluded that in a developing country it is advisable to create a single institution incorporating responsibility for quality control, standardization, and metrology because of limited economic resources and a scarcity of experts. This opinion is shared by the authorities of the USSR*. Most industrialized nations, on the other hand, establish independent organizations in each field. The U.S., for example, with literally hundreds of standardizing organizations, appears to have reached a consensus that centralization of this effort is impractical. However, in recent years this consensus has shown a trend toward great coordination of effort and the general acceptance of the necessity of Federal support. In the U.S., the responsibility for weights and measures regulation is a function of state and local rather than central government, although the Federal establishment maintains the basic standards of measurement and provides technical assistance to weights and measures officials. This rather complex system derives not only from the checks and balances inherent in the American system of government, but in the historical, slowly evolving relationship between industry and government. The U.S. team members believe that such a system would not provide optimum short-term benefits to the Korean economy. Survey team representatives from U.S., Ecuador, and Turkey are in agreement on the desirability of an intermediate level of centralization.

In a following section the problems connected with standardization and measurement services in Korea are summarized. The conclusion is inescapable that Korean industrialization and commerce, its technology, science, and the entire economic growth are being

*V. M. Ograyzkov's recent relevant article is translated from Izmeritel'naya Tekhnika No. 4, pp. 16-21, April 1970. (A copy of this article is available from the Plenum Publishing Corporation, 227 West 17th Street, New York, New York 10011, for $15.00).

handicapped by the absence of a central responsibility and some relevant facilities for such services. The Korean Government has already reached that conclusion and placed strong ministerial support on careful planning and vigorous action leading to the establishment of an effective Office of Industrial Promotion.

IV. THE PROBLEMS OF CONCERN TO THE KOREAN SURVEY TEAM ON A NATIONAL CAPABILITY IN STANDARDIZATION AND MEASUREMENT SERVICES

Individual Korean scientists perform as equals with the world's most distinguished. Korean workmen have been readily trained to be unexcelled in skill and concentration span. The Korean economy has sustained for many years an unexcelled growth rate. Yet the magnitude of the Korean balance of payments gap, the difficulties preventing wider acceptance in world markets of Korean products, and other symptoms have caused the Government of Korea to examine the opportunities for the next big push forward for Korean industrialization and economic progress. In Korea today, in the eyes of its forward-looking Government, the greatest need in the promotion of technological development is standardization in conjunction with metrology to bring control of quality and quantity to industry and commerce. The first and perhaps foremost task facing the Survey is to answer the direct question: what does Korea need for optimum systems of standardization and measurement techniques in support of Korea's ambitious industrial goals? What indeed are the problems?

Prior to the NBS/AID team members' arrival, most of the problem areas had, in fact, been identified by the Korean study team. The entire survey team now confirms and articulates the following principal problems:

1. Korea lacks a central focal point for standardization directly based on current technology and measurement science. The need for such a central responsible agency has been judged to be a cardinal feature of the industrial structure of virtually all highly developed nations, and is fully explained in another section of this report.

2. Industry and the public in Korea seem not widely aware, and certainly do not widely advocate standardization and quality control procedures. Only a few enlightened industrialists see the assurance and the savings, which typically far outweigh costs and troubles.

3. Korea lacks a central system of surveillance of the "markets" at which the public buys by weight, length, volume, or number. The measurement and calibration procedures on which such surveillance must be based are not clearly seen to be under control for the protection of the public with a basic right to equity in the market place.

4. A central responsibility needs to be fixed for ensuring a national capability to make the diverse measurements and suitable calibrations for production and quality control in industry. There is presently no effective national authority by whose competence compatibility of products can be assured for exports, imports, and internal trade.

5. Korea needs more standards to be written based on wider consensus of buyers, sellers, Government interests, and technical guidance on available test methodology. Flexibility in providing incentives for participation in standards writing is needed. Old standards need also to be revised by effective consensus. The Korean Bureau of Standards does not presently work in close support of all branches of Korean Government in all areas where there is a need for standards. The team was particularly struck by a need for safety standards to be promoted by the Ministry of Health and Social Affairs.

6. The excellently conceived KS marking scheme lacks adequately wide recognition by the public and even by the Government in its purchasing policies. Hence the system lacks visible incentives to the manufacturer. Further, the manufacturer lacks advice on quality control of his own raw material and on production controls for reducing wastage through inspection rejection and returns. Most of all, the system fails to provide for follow-up testing with control from a central authority, probably desirable even though the testing programs might be distributed among many accredited laboratories. Policies on limited guarantees and warranties need to be widely discussed and, eventually, regulated.

7. In Korea today many units of measure are in use. Many are taken from ancient systems. Others arise from close ties with friendly nations that are also still striving toward a wider use of a single internationally recognized system of metric units. The current situation leads to confusion, misconception, error, fraud, and unnecessary proliferation of products, types, and spares.

8. A critical need for expansion exists for product test laboratory facilities in the service of industry. Metrology in such facilities must be controlled through calibration or equivalent services.

9. The development of effective workable standards depends on selected methods of test. Experimentation and research in test methodologies are essential, and are presently not provided by the Korean Bureau of Standards.

10. National responsibilities in standardization and measurement science made a strong governmental involvement inevitable. However, current staff salary and benefits policy makes it virtually impossible to recruit and hold in government services key staff members who

represent real scientific or technological expertise, who combine true devotion to the public need with absolute integrity and impartiality. Korea lacks a national pay scale for highly qualified scientists and engineers that could attract them into temporary government posts without tenure rights. Such scales in some countries are effectively structured to fit technical excellence irrespective of administrative level.

11. Small and medium size industrial units under entrepreneurial management cannot afford to hire professional scientists and technologists. Similarly, they cannot afford to provide and equip modern laboratories for their short-term technical problem identification and solving, as opposed to the wider, longer-range research and development work offered by KIST.

12. Industry and Government have difficulties in obtaining access to a centralized standards information service with news and analysis on what other countries and international organizations have published and on what novel useful results are emerging. The technologists lack access to critically evaluated standard reference data based on a worldwide analysis of world literature.

13. In standards and measurement science, Korea seems to be inadequately in touch with regional and international programs through effective participation in such activities. (The team considers that the cost of selective involvement is small compared with benefits from learning through association.)

14. Korea appears to have no central technical service aimed at minimizing the risks of disasters occurring and at analysis of actual failures of major machinery or structures.

15. Korea lacks a widespread wish for and encouragement of vigorous inter-institutional collaboration at professional levels below top management. In a modern diversified industrially developed society, such collaboration is believed to be essential. In particular, ties between universities, industry, and government laboratories in Korea today are not as strong as is desirable.

16. Korean standards and measurement science activities lack coordinated training functions.

17. Metrology and standardization services are subject to many problems common to all countries. The Government realizes that predetermined answers to all common problems cannot be provided. Perhaps the most subtle of these problems is how to respond to the need in metrology to provide necessary redundancy. Whereas in most other operations overlap must be avoided, in metrology some overlap is essential. Yet no such overlap should be tolerated in governmental

regulatory functions or responsibilities for the operation of systems such as those of national metrological units, of accreditation of test laboratories, extension services, etc.

18. Another common problem is that of effecting a gradual change in the character of the metrological system. In this evolution, the system passes from one based on a rigid hierarchy of physical standards vertically linked by calibration of instruments, to one based partly on calibration and partly on other approaches. These include round-robin testing, standard reference materials, and measurements at the highest achievable precision by several laboratories of the same properties on samples of the same material.

19. No list of common problems in metrology could be complete without mentioning the exponential rise of costs with level of measurement precision. Very roughly, it takes ten times the cost to halve the uncertainties. No country requires across-the-board metrology of highest accuracy for its technology. The U.S.A. and other highly industrialized countries can no longer afford the cost escalation at the highest attainable accuracy. Enormous savings are achieved by examining the real needs at the factory bench and aiming to deliver that and only a little more. Surely the benefit to cost ratio must be analyzed for each and every measurement service. The problem is to provide for such a metrology service in terms of current real needs of industry.

V. CONCLUSIONS AND RECOMMENDATIONS

The NBS/AID Korean Survey Team has presented its main conclusions and recommendations on standards and measurement services in the Republic of Korea to the Ministers of Commerce and Industry (MCI) and of Science and Technology (MOST) who were the patrons of the Survey. These conclusions and recommendations were also discussed at greater length with senior staff of these ministries. The text of the draft report was translated into Korean. The essence of the favored solutions of the problems outlined above is contained in the description of the following 20 basic functions which in the Team's opinion should be exercised in standardization and measurement services in response to existing and growing needs of Korea.

A. Legal Metrology Service (Weights and Measures in Retail Trade)

B. Consumer Protection and Maintenance of Quality of Environment

C. Standards Development

D. Fundamental Metrology Service, including Calibration of Physical Standards and Instruments

E. Development of Test Methodology for Products

F. Coordination of Accredited Test Laboratories

G. KS Marking

H. Information and Publications Service

I. Industrial Technical Extension Service

J. Natural Resource Management

K. Assistance in the Exploitation of Inventions and Innovations

L. Organizing of Advisory Councils and Panels

M. Staff Selection and Management

N. Training in Standards and Measures

O. Disaster and Failure Avoidance

P. Scientific Instrument Design, Construction,and Maintenance

Q. Hiring Foreign Expert Advisors

R. Overall Planning

S. Computer Services and Data Links

T. The Principal Technical Resources and Their Management

The national administrative and technical focal point for exercising most if not necessarily all of these service functions could be the new Office of Industrial Promotion OIP whose tentative organizational structure is shown in Figure 1 (for abbreviations, see the appendix). Of the three OIP Departments headed by Associate Directors that for Patents is not here described. The Team was neither really competent in this important field nor was there time to investigate the relevant Korean activities and current laws. The assumption has, however, been made that this Department will provide services not only in patents and patent information, but also for registered models, trade marks and all kinds of industrial technical property.

The second Department would be under the Associate Director for Industrial Services. It is concerned with diverse functions. OIP

staff can interact directly with industry giving technical advice from the Bureau of Extension. Working in a collaborative manner seeking consensus suits the Bureau of Standards. Work in the regulatory mode for compliance with laws and regulations is left to the Bureau of Inspection. The most appropriate image of these three Bureaus make some clear delineation of functions between them essential.

The third Department, under the Associate Director for Technical Services, provides the in-house technical and laboratory skills. Three Bureaus differentiated by disciplines are suggested; they could equally be called institutes and would be largely staffed by specialists in close touch with academic science, world wide technology and engineering, and could be at call for small Korean industrial units usually through intermediaries in the Bureaus of Extension, Standards or Inspection.

The NBS/AID team believes that almost the entire OIP should be in one central location near to other major centers for science and technology to promote interaction between specialists. Proximity to the Korean Science and Technology Information Center (KORSTIC) could also be a consideration. Industrial representatives would then receive information of prime interest to them on foreign and international standards near to the KORSTIC organization where other technological information is centered.

The 20 service functions and the corresponding responsibilities within the proposed organizational structure of OIP are listed separately. Estimates of staff building and budget requirements were given in the verbal report. All these recommendations are tentative, and should be considered to be the best judgment of the Survey Team based on only its short study of the situation. A great deal of planning should precede implementation. In addition, a careful scheme of priorities and sequences will be needed for that implementation. The stress should always be first on the recognition of a real need based on trade and industry goals. Second should come the establishment or strengthening of the service function to meet the need. The full use of existing Korean facilities is essential. With technically well qualified, well motivated young, well compensated staff, vigorous technical services can be given to Korea.

A. Legal Metrology Service (Weights and Measures in Retail Trade)

(This first function is described in a little greater detail than others because it serves as an illustrative example. Even for this function a great deal more detailed planning is needed.)

1. Mission: The aim of this service is to ensure that quantity descriptions in the shops and markets, as well as in the

exchange of materials involving commercial companies are clearly and accurately represented in terms of legal units of measure. Almost all quantity descriptions are in terms of number count, mass (weight), length, or volume units. Representations of these units of measure shall be maintained in relation to the internationally defined units to an accuracy in excess of the most precise legally required measurements.

2. Organizational Structure: In the proposed Bureau of Inspection (BOI) there could be a Division of Weights and Measures (DWM) with the central responsibility for execution of the above mission. The technical support for the execution of this mission rests on the Bureau of Physical Technology (BPT) (Division of Fundamental Technology (DFT); Mass, Length and Time Section). The more routine maintenance of measuring units and instrumentation should be carried out within the Fundamental Units Section of the DWM in BOI. For the system of legal metrology to be under control, arrangements must be made for periodic comparisons of Korean physical standards with other national and international standards; similarly city and provincial master standards must be linked in a system of Korean national standards. Part of this function can be contracted to KIST which is well equipped for this purpose. The duplication of such facilities within Korea or the re-housing of the existing laboratory elsewhere would be unjustifiably wasteful. The Team believes that this is just one example of how Korean services should be built up from existing facilities which should be used in mutual support rather than replaced by OIP. The technical services which are now available outside OIP and which for various reasons cannot be incorporated in OIP should be used by subcontract controlled through a system of accreditation of outside laboratories, which might be organized by the Division of Quality Control (DQC) in a Section of Accreditation (see F below).

Seoul, Pusan, and the provinces would each need a small Branch Laboratory under (supervision of) DWM for the comparison of field standards with the provincial master standards. The Branch Laboratories would have similar equipment already available in most provincial laboratories.

As the field function is mostly one of prevention of fraud, it could possibly be given to specialists in the police force, who would give warnings and, if necessary, prosecute. The police might also share with the branch offices small certification fees which would, however need to be collected centrally so that no exchange of money has to take place for that purpose in the field.

There would have to be a Section of Scales and Instruments under DWM. The basic technical support would again come from DFM for calibrations and from the Division of Derived Metrology (DDM) for type approval. The city, provincial, and field functions would be undertaken by the same organizations which fulfill the physical standards functions.

Weights and scales for loads in excess of say 100 kg need exceptional central facilities. This service should be handled by a Section for Large Weights maintained in DDM of BPT. Strain gauge and proving ring methods of test should be developed and authorized, where adequate, to save wherever possible the expensive movement of large loads. Part of this work could be subcontracted to KIST by the Accredited Laboratory procedure.

B. Consumer Protection and Maintenance of the Quality of the Environment

1. Mission: The aim is to protect the public against false or misleading advertising; incorrect, insufficient, or confusing labelling on packages; purchases of grossly inadequate quality of products; and unsuspected hazards or contaminations.

2. Organizational Structure: In BOI an initially small Division of Consumer Protection (DCP) should be concerned with package labelling, environmental quality, and the measurement of quality and safety of consumer products. Techniques and benefits from consumer surveys will be studied. Technical support would again be sought from the Department of the Associate Director for Technical Services.

C. Standards Development

1. Mission: The aim is to serve Korean industry, agriculture, forestry, public health, commerce, and internal and external trade by promulgating standards, codes, and typical specifications. The standards and codes are based on consensus of experts representing manufacturers, purchasers, independent technical authorities, and the public. Manufacturers must be given the opportunity to assess the advantages of participating and using standardization. It will enable them better to control raw materials and production processes; limit types and sizes in production; simplify the provision of spares; reduce waste and save costs on customer complaints. Above all, standardization and quality control are essential for successful trading in world markets.

2. Organizational Structure: The existing Korean Bureau of Standards (BOS) can be readily adapted to the greater responsibilities contemplated. It is here suggested that it should have four Divisions on Industrial and Agricultural Standards (DIAS), Building Codes (DBC), Safety Standards (DSS), and Information and Publications (DIF). The first three Divisions will provide administration for a complex standards committee structure; seek advice on selection of standards; prepare first drafts; circulate, discuss, and revise drafts; obtain consensus and obtain approval of the Minister of Commerce and Industry, plus the Minister of any other Ministry directly interested in the standard concerned; and promulgate the standard.

The mechanism for developing standards should be based on a system of standing committees constituted by subject with up to 10 members representing all interest elements and serving for about three-year terms. Meetings of each committee should take place at least twice a year. Travel expenses should be offered by OIP but no fees except that they might be considered for private individuals representing consumer interests. All detailed drafting and discussions on individual standards, codes, and specifications should be done in working groups under authority of the above committees. Meetings should take place as judged necessary by the chairmen of the working groups who are appointed by the parent committee. Travel expenses, and limited fees for private individual members of working groups should be given by OIP as for the parent committees. All draft standards, codes, and specifications must be approved by parent committees, Division Chiefs, and Bureau Chiefs before submission to the Ministers concerned. The BOS is thus seen as serving any executive agency that needs to promulgate standards, although the enforcement of any mandatory standards would only be the function of OIP when the Ministry of Commerce and Industry is involved. Even in such cases it would be BOI rather than BOS that would be required to fulfill such a regulatory function.

D. Fundamental Metrology Service Including Calibration of Physical Standards and Instruments

1. Mission: To provide the scientific activities underlying the measurement system, the aim is to give Korea a nationally recognized and internationally compatible representation of every significant and legal unit of measure used in science, technology, industry, and commerce (excluding monetary units). This representation may be in the form of a physical standard or group of intercomparable standards; it may be in the form of measuring instruments calibrated against each other and

compared with some standard reference material; or it may be in the form of critically evaluated and internationally recognized bench mark data contacted by an experiment. These representations need not necessarily be the embodiment of their internationally recognized definitions nor all be located at OIP or even at an accredited test laboratory. However, it is expected that OIP be the national focus of knowledge, reference and judgment on all fundamental questions of metrology in Korea for base and derived units of measure. It is also expected that the majority of basic measurement standards would be accessible at the laboratories of OIP.

2. Organizational Structure: It is proposed that the fundamental metrological responsibility be mainly concentrated in the Division of Derived Metrology (DDM) in the Bureau of Physical Technology (BOPT). Some aspects might be delegated to laboratories accredited for this purpose. For example, radiation dosimetry might be delegated to the Atomic Energy Laboratory in the Office of Atomic Energy.

E. Development of Test Methodology for Products

1. Mission: The aim is to assure and enhance the validity and reliability of product testing methods and the system for their use, and to provide the basis for new methods of test supporting the development of proposed, new or improved standards as their needs become apparent. Test methodology considerations involve activities of a research nature. Relevant parameters have to be identified, and valid and reproducible experimental techniques for their measurement developed. Results of such activity must be consolidated into precise statements of test procedures. Finally, there is an "extension" aspect in which it is necessary through devices such as training, laboratory comparisons, standard reference materials (SRM's),etc., to transfer the test methodology to the point of use and ensure its effectiveness "in the field".

2. Organizational Structure: Development of test methodology may be requested by the BOS, BOI or BOE on a partly internally reimbursable basis from most of the Divisions under the Associate Director for Technical Services, wherever there exists appropriate technical expertise.

F. Coordination of Accredited Test Laboratories

1. Mission: Under this function it is the aim to organize, maintain and administer a voluntary laboratory approval registration scheme for test laboratories of excellence throughout Korea and to make use of their services for the benefit of OIP. Applications

would be expected from firms, universities, and governmental as well as private institutions having special laboratory facilities and willing to undertake calibration or testing. Accreditation is given if a) adequate knowledge of a particular field for which accreditation is sought is demonstrated, b) appropriate equipment is available, c) premises are suitable, d) staff is thoroughly competent and of integrity, e) relevant prior experience has been reported.

2. Organizational Structure: This service could be organized by by a Section of Accreditation in the Division of Quality Control (DQC) in BOI. To execute this OIP function effectively is a challenge in administration of technical resources. To verify and maintain the excellence of the accredited laboratories DQC must make use of the in-house technical judgment in OIP. In assigning tasks to laboratories the services of the accredited laboratories are supplementary and competitive to other services within OIP. As Korean industry grows, more and more of the routine testing will be done by accredited test laboratories, while more and more of the non-routine critical tests can be best done within OIP.

G. KS Marking

1. Mission: The aim is to enable a manufacturer to gain public recognition of the sustained high quality of his products. The pre-existing system to be administered by OIP must receive wider public recognition ultimately based on valid independent quality checks or warranties. Governmental purchasing of KS products where available needs to be made the rule. Recognition of the assurance provided by the KS symbol will follow.

2. Organizational Structure: A Division of KS Mark (DKSM) in BOE would be given the responsibility of organizing an effective KS marking system drawing upon the technical expertise both within OIP and through the system of accredited test laboratories.

H. Information and Publications Service

1. Mission: The aims are to provide information services, including collection and maintenance of world standards literature, in support of the operations of OIP; to publish Korean standards; to disseminate to industry, other agencies, and the public, technical information on standards, test methods, codes, specifications, and relevant experimental results; to provide general information services to promote public and industrial acceptance of improved standardization practices; to promulgate consumer information on product testing; and to provide other

national, regional, and international standards organizations with news of Korean standards and standardization procedures. The Korean manufacturer who competes in world markets should have his voice heard in the framing of standards to which his products have to conform.

2. Organizational Structure: A Division of Information and Publications (DIP) within BOS is given all of this mission responsibility. It may help to publish a monthly news bulletin with English abstracts for no-cost exchange with other national standards journals.

I. Industrial Technical Extension Service

1. Mission: The aim is to make available to Korean industrial companies on request the technical knowledge and competences represented in OIP. Modern industry is in need of technology transfer and problem solving resources made up of expert representation in many technical specialties. Such a balanced team of scientists and technologists can be provided by the largest multi-national firms and the Government in Korea, not by individual Korean firms. The availability to locally based industry of this type of knowhow could greatly improve the Korean manufacturing capabilities and thereby favorably influence the balance of payments. Longer range applied research might be referred to KIST, but OIP should assist in making firms aware of the potential benefits of such research and help to state the applied research problem for the teams at KIST. Other examples of persuasive interaction between OIP and industry concern wider adoption of metric units, more extensive manufacture to Korean standards and the KS mark assuring quality, and wider support of OIP's general mission through other laboratories which apply for accreditation by OIP.

2. Organizational Structure: A Bureau of Extension (BOE) under the Associate Director for Industrial Services could accomplish the above Mission. It could have four divisions of which the following three are not otherwise covered in systems described before. They are:

   a. Division of Consultation (DC)

   b. Division of Metrication (DM)

   c. Division of Systems Analysis (DSA)

J. Natural Resource Management

1. Mission: It is aimed to explore, survey, develop, exploit,

conserve and administer Korean natural resources to public benefit.

2. Organizational Structure: This very important mission would be the principal concern of a Bureau of Natural Resource Technology (BONRT) divided into six divisions as follows:

Division of Geological Survey (DGS)

Division of Ore Dressing and Extraction Metallurgy (DODEM)

Division of Mineralogy and Mining (DMM)

Division of Water and Oceanography (DWO)

Division of Fossil Fuel (DFF)

Division of Air Quality (DAQ)

K. Assistance in the Exploitation of Inventions and Innovations

1. Mission: To disseminate throughout Korean industry the spirit and practice of seeking technical inventions and innovations including those concerned with measurement of product quality. Industry will need advice also on exploitation of such inventions and innovations in order to increase profits to industry.

2. Organizational Structure: This function can be fulfilled by the members of BOE, in collaboration with universities and other educational institutions.

L. Organizing of Advisory Councils and Panels

1. Mission: The aim is to furnish annual independent advice to the Minister of Commerce and Industry and other appropriate Cabinet Members on the effectiveness and quality of OIP's staff, work and services. Visible praise and criticism, new programs, and major budget changes are often more readily noticed from outside than when they are given from within the organization concerned. Inasmuch as the members of the councils will be leaders of industry, universities, chambers of commerce, independent and other governmental institutions, these council sessions will help to disseminate widely the work and results of OIP programs.

2. Organizational Structure: Approximately twelve top leaders of industry, universities, government, and private institutions might be appointed by the Minister of Commerce and Industry to a five-year term of office on a Council on Industrial Technology.

This Council shall meet at OIP premises no less than two days per year and submit an annual report to the Minister of Commerce and Industry for discretionary publication to the Korean public.

Six of the above Council members might be the Chairmen of the following eight-men bodies (corresponding to the Bureaus of OIP).

a. Inspection Council

b. Standards Council

c. Extension Council

d. Council on Physical Technology

e. Council on Chemical Technology

f. Council on Natural Resources

The specialized Councils shall report annually to the Director of OIP and the Council on Industrial Technology upon the work of the Bureaus. Those reports might in part be based on four-men Advisory Panels whose duty it would be to report annually to the Bureau Chiefs and the above Councils on the work of OIP Divisions. Membership of the Bureau Councils shall include elected Chairmen of all the Advisory Panels of the relevant Divisions of the Bureaus. Appointment is by the Director of OIP with due regard for relevant competence in the fields covered by the Divisions. No Panel or Council shall be without at least one representative of universities and one from independent laboratories such as KIST, KAIS, or FIC.

Secretarial facilities shall be given to the Councils from the Programming and Planning Branch (PP) of OIP.

M. Staff Selection and Management

1. Mission: OIP should be staffed only with well-motivated, hard-working, devoted individuals of unimpeachable integrity who are either acknowledged experts or have considerable professional growth potential. This aim can only be satisfactorily achieved through close recruitment contact with leading universities in Korea and abroad. The careful selection of the top leaders is one of the keys to industrial growth of Korea. To secure and maintain such technical staff in a governmental organization has been judged impossible. However, without such staff OIP will surely fail.

With new laws, if necessary, incentives for recruiting and holding OIP technical personnel must be sought. Suitable mechanisms might include:

a. a bonus for coming on duty, such as family transportation costs from abroad

b. special housing facilities

c. prizes and awards based on performance

d. encouragement of concurrently paid adjunct professorship duties at nearby universities, perhaps subsidized by OIP to provide relevant courses which will benefit the universities and students, as future employees to industry

e. opportunities on merit to all (including women) for advancement

f. special retirement benefits that would increase with length of service

g. promise of in-service training including assignments abroad

It should always be remembered that a technical agency can never be better than its technical staff. The best buildings, the best instruments are worthless without the skill and devotion of the personnel that operate them.

2. Organizational Structure: A strong Personnel Section in the General Affairs Branch (GA) of OIP is needed to recruit and develop staff.

N. Training in Standards and Measures

1. Mission: The aim is to give every OIP staff member an opportunity for growth in skills and knowledge and to bring new competences to OIP even from abroad. In addition, OIP facilities should, as far as practical, be put at the disposal of neighboring universities that might seek such interaction. Conversely, the universities might by contract provide part of the technician and professional refresher courses for OIP staff and nominees from industry. OIP staff would need instruction in effective methods of disseminating throughout industry an awareness of standards, measurement and quality control. However, training to benefit other than OIP staff is not considered under this OIP function.

2. Organizational Structure: A Staff Training Section in GA.

O. Disaster and Failure Avoidance

1. Mission: The aim is to protect life and property and to improve quality and safety of structures, bridges, roads, railroads, power plants, fuel storage facilities, components and industrial products. This is achieved through technical analysis of the underlying physical causes of failure in service of structures, components, etc. Information and other technical services are provided for the effective application of the results of these analyses to the development of standards, codes, specifications, test methods, and procedures, as well as to the prediction, detection, and avoidance of incipient failure.

2. Organizational Structure: A Division of Disaster and Failure Avoidance (DDFA) is to be set up in BOPT. The technical facilities of this Division will be heavily engaged in support activity for BOI, BOS and BOE.

P. Scientific Instrument Design, Construction and Maintenance

1. Mission: To provide a national focal point for technical know-how on instrument construction, calibration, operation, and maintenance. Awareness of the world state of the art and the competitiveness of alternative instrumental measurement systems in needed to advise industry, for example, on the wise choice of imported instruments.

2. Organizational Structure: This function will be fulfilled by the Division of Derived Metrology (DDM) in BOPT; and wide use should be made of accredited test laboratories such as FIC through the services provided within DQC.

Q. Hiring Foreign Expert Advisors

1. Mission: The aim is to give OIP the benefit of high level administrative and technical assistance from experts abroad, who should be accompanied by Korean counterpart officials to interpret Korean industrial practices and be prepared to acquire knowledge, skills and experience from the visiting experts.

2. Organizational Structure: This function will be best fulfilled by the specialist division concerned but the foreign experts will in general be assigned to the Offices of the Director, Deputy Directors, or Bureau Chiefs. GA will make appropriate arrangements.

R. Overall Planning

1. Mission: To advise the OIP Director on all programs and budget planning encompassing all OIP systems, functions, services, and facilities. They must be evaluated in terms of national priority goals and needs of Korean economic and industrial growth. Programs must make the technical standards and measuring facilities of OIP available to all other government agencies at their request.

2. Organizational Structure: The Program and Planning Branch (PP) is to serve the above function.

S. Computer Services and Data Links

1. Mission: The aim is to make available to all OIP work and services the benefits of computer useage for scientific, administration, and record functions, and to provide access to technological data bases from all over the world by satellite, cost sharing, and other mechanisms. The aim is also to advise Korean industry on applications of and opportunities in computer science and technology such as on the manufauture of possible electronic auxiliary devices for computers. The competences of KIST should be called upon to the maximum extent practical.

2. Organizational Structure: This function involves DDM in BOPT and DSA in BOE.

T. The Principal Technical Resources and Their Management

The above summary of the primary technical functions and services as seen by the Survey Team barely mentions the technical expert services needed for implementation. These specialized services are arranged by discipline within the technical Bureaus and are expected to interact with each other and with all groups in the Bureaus concerned with direct industrial services.

For example, the Division for Analytical Chemistry (DAC) of the Bureau of Chemical Technology (BOCT) provides chemical analytical services whether it is to establish the safety of a food for DS, or to establish the compositional standard test of a concrete for DBC, or to advise a pharmaceutical company on routine quality control of some raw material (purchased from a variety of sources) through the intermediary services of DC.

This cooperative and interactive management is the key to the economical effective supply of specialized services, for any modern and progressive industrializing society. In a country like Korea where the practice of vertical line management is common, it becomes necessary to make a considerable effort to practive communication between operating groups without referring always to a common superior high in the administrative scale. Clearly the organization of one OIP serving all of Korea makes such interaction easier. However, the ministries responsible for power supply, for example, will not want a standards setting procedure for, say, electrical generator equipment without having a strong voice in the formative phases and a veto over adoption procedures. The consensus principle must apply.

Equally important are the relationships within OIP. Operations within DS must be able to discuss problems within DSS staff concerned without routing an inquiry up and down the line to and from the Associate Director level. To begin with, OIP will find it very important to have one of its own units designated to effect these cooperative relationships both internally and with groups external to OIP. DSA could be so designated.

Appendix 1

Abbreviations Used of Organizational Elements of the Office of Industrial Promotion

BOCT	Bureau of Chemical Technology
BONRT	Bureau of Natural Resource Technology
BOI	Bureau of Inspection
BOS	Bureau of Standards
BOPT	Bureau of Physical Technology

DAC	Division for Analytical Chemistry
DAQ	Division of Air Quality
DBC	Division of Building Codes
DBT	Division of Building Technology
DC	Division of Consultation
DCP	Division of Consumer Protection
DCPC	Division of Chemical Process Control
DCPV	Division of Chemical Product Verification
DDFA	Division of Disaster and Failure Avoidance
DDM	Division of Derived Metrology
DFF	Division of Fossil Fuel
DFM	Division of Fundamental Metrology
DGS	Division of Geological Survey
DIAS	Division of Industrial and Agricultural Standards
DIP	Division of Information and Publications
DKSM	Division of KS Mark

DM	Division of Metrication
DMM	Division of Mineralogy and Mining
DODEM	Division of Ore Dressing and Extraction Metallurgy
DQC	Division of Quality Control
DS	Division of Safety
DSA	Division of Systems Analysis
DSS	Division of Safety Standards
DWO	Division of Water and Oceanography
DWM	Division of Weights and Measures

GA	General Affairs
LC	Legal Counsel
OIP	Office of Industrial Promotion
PP	Programming and Planning

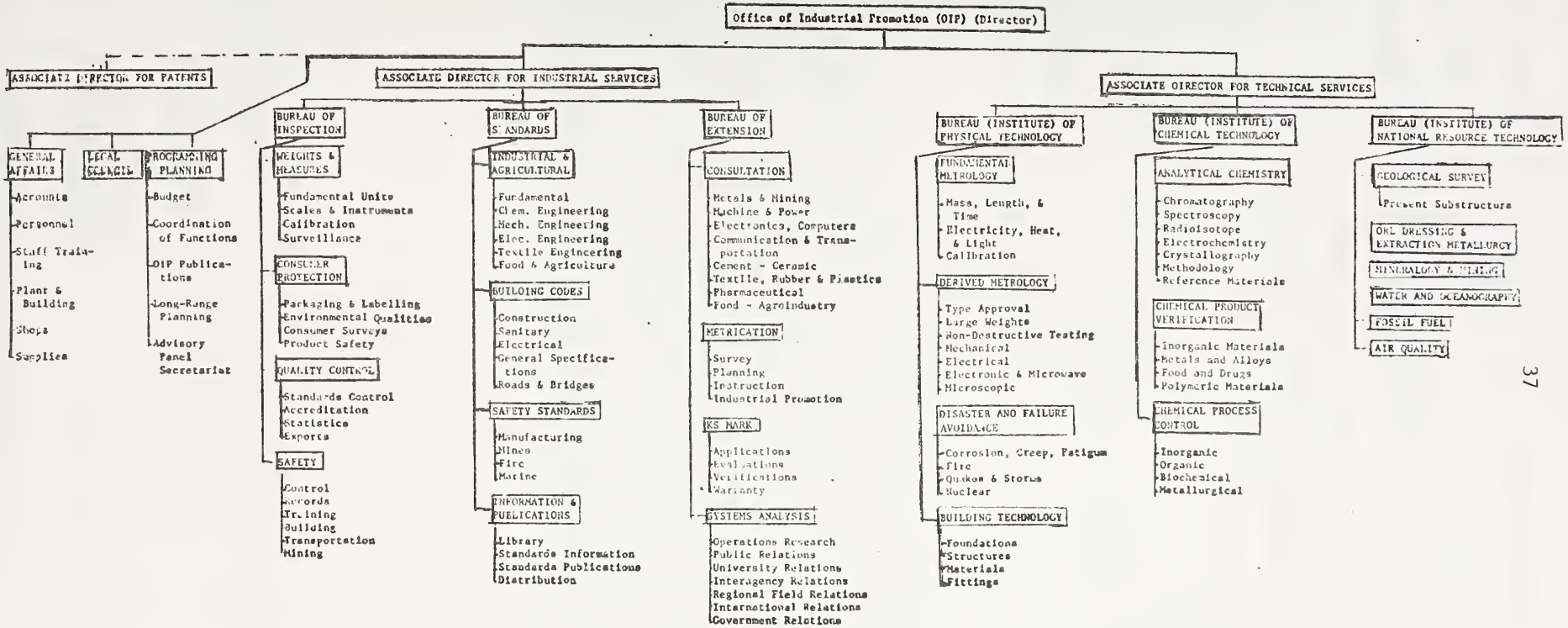

Fig. 1 Tentative Organizational Structure of the Office of Industrial Promotion

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The survey of standardization and measurement services for developing industries in Korea has been carried out by NBS with funding by AID, participation by representatives of Ecuador and Turkey, and under the guidance of the Korean Ministers for Commerce and Industry, and for Science and Technology. The Korean Director of the Survey was backed by six Korean Survey Team members and seven senior staff. The Survey Team spent two weeks in Korea where it inspected representative laboratories and plants, and had discussions with leaders of Government, the USAID Mission, principal universities and industry. The Report describes the preparation for the Survey, a summary of the economy of the country notes on Korean science and technology, and relevant Korean institutions and laws. Nineteen problems were identified as of concern to national capability for standardization and measurement services. A summary description is given of the various existing and needed functions that Korean government should provide. The idea is endorsed to create a single agency to address all these functions.

17. KEY WORDS (Alphabetical order, separated by semicolons)

AID; assistance; economics; LDC's (less developed countries); measurement services; standardization; survey; Korea

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