Status of Precision Measurement Technology in Korean Industry, 2000

- Results of survey study of 1,281 manufacturing firms -

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요 약

기반기술로서의 정밀측정기술은 그 중요성이 인식되고 있으며, 본고에서는 우리나라 산업체에서의 정밀측정기술 현황과 문제점을 실태조사를 통해 과거의 조사자료와 비교분석하고, 그 발전방안을 제시하였다.

Ⅰ. Introduction

We are now live in the new millenium which are high expenses, high competition, and high speed of circumstantial change. We have experienced the economic difficulty by suffering the IMF management in 1997. Now, we are undergoing the economic obstacle.

We have experienced the negative factors of industrial products and exports such as the conflict between labor and management and the world-wide expansion of the protective trade policy. In such a circumstance, we have to overcome the difficulties by producing competitive products through the improvement of precision measurement technologies.

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Today, even in the developed countries, it is recognized that the improvement of measurement control will ensure the development of the industries and the technologies. The measurement control is not limited only to the problem of the production activities, but also related to the national standards in various areas, covering the circulation of products and consumption, space science, economy, and cultural activities.

Korea Research Institute of Standards and Science(KRISS) has carried out a series of nationwide surveys to confirm the capability of accurate measurements in Korea industry from the year of 1977. This survey which was were authorized statistics by the government of Korea (National Statistics Administration, Recognized No. 33201) is performed biennially. In 1999, the survey research team of KRISS conducted the 12th survey on the status of precision measurement standards in domestic industries.

The study aims at surveying the current status of precision measurements such as the uses and maintenance of measuring instruments, precision and accuracy grades, man-power, standards laboratories etc. in order to obtain statistical data on the capability of precision measurements in domestic industries, and thereby to suggest the solution of precision measurement-related problems in Korean industries. The results of the study would be expected to make a contribution to the promotion of international competitiveness of Korean industries.

The study covered and analysed various areas: measurement areas, precision and accuracy grades, measuring man-power, countries of manufacture, calibration status, calibrating organizations and periods, and utilization of measuring instruments, and the number of years in use, and possession of standards laboratories.

For the investigation, the questionaire forms on measurement status were surveyed 1,281 randomly selected industrial firms. (Table 1) shows the number of firms which responded our questionaire. The firms are classified by the number of employees.

(Table 1) Number of firms which responded questionaire

Employees	20 - 49	50 - 99	100 - 199	200 - 299	300 - 499	500 -	Total
Number of firms	303	376	295	111	60	136	1,281

576 kinds of measuring instruments were surveyed and the collected data of measurement areas were distributed into the classification of firms according to, first, their products and, second, the number of their employees by using Neymann's distribution method.

Ⅱ. Status of measurement technology in Korean industries

1. The whole production of measuring instruments of machinery manufacturing industry amounts to only 0.49% of total production in domestic industries. In 1999, Korea exported measuring instruments of 292 million dollars, while it imported measuring instruments of 1,878 million dollars for the same year. As the result of this big excess of imports, 55.4% of measuring instruments used in manufacturing companies are made in Japan and only 27.7% of them are made in Korea. This fact shows that Korean manufacturing companies heavily depends on the measuring instruments produced in Japan.

Meanwhile, the survey shows that the average number of measuring instruments per manufacturing company in Korean industry is about 395 in total measuring instruments.

2. Concerning the distribution of measuring instruments in domestic industries, the survey indicates that standard instruments amounts to 1.3% of total measuring instruments, reference instruments, working-standard instruments, routine instruments amount to 4.3%, 28.4%, 66.8% respectively. (see table 2)

The ratio for high grade measuring instruments such as standard instruments and reference instruments is no more than 6%, which may be an obstacle to reach the stage of technology-intensive industry of developed countries in the near future.

(Table 2) Change of the level of precision and accuracy in measuring instruments

(unit : %)

Grade Year	Standard Instrument (1st-3rd grade)	Reference Instrument (4th-5th grade)	Working - Standard (6th grade)	Routine Instrument (7th grade)
1977	0.8	4.0	6.3	88.9
1989	1.3	8.7	34.1	55.9
1999	1.3	4.3	28.4	66.0

3. The ration of calibration for high grade measuring instruments including standard and reference instruments, which should be calibrated periodically, indicates 37.8% in 1977, 75.1% in 1989, and in 1999 the ratio of calibration increased to 82.5%. This means that understanding for the calibration in manufacturing companies has been greatly improved. (see table 3)

(Table 3) Change of the ratio of calibration

(unit : %)

Year	1977	1981	1985	1989	1993	1995	1997	1999
Ratio of Calibration (high grade instrument)	37.8	48.8	64.7	75.1	69.3	78.9	81.0	82.5

However, the fact that 17.5% of high accurate measuring instruments are still used without any calibration implies that a considerable number of manufacturing firms in Korea still neglect calibration for their measuring instruments and fully understand the significance of measurement standards.

As for the calibration agencies for measuring instrument, 12.4% of total measuring instruments have been calibrated by unauthorized calibration agencies.

4. 9.5% of total measuring instruments are not used due to breakdown and the suspension of service. 3.9% of unused measuring instruments are out of order. Industries tends to avoid reoperating these unused instruments, mostly imported at high prices, because of the high cost of repairing and maintenance. Consequently, the ratio of unused measuring instrument has deepened, which is one of various factors to be a burden on the cost of production in industries.

5. As to the measuring personnel who takes exclusively charge of measurements in domestic industries, there are averagely 1.9 persons who are 1% of total employees. The large scaled firms averagely secure manpower of 8.5 persons, while the small-medium scaled firms have only 0.7 person for measurement. Thus we can realize that the measurement control is small scaled companies.

It is observed that most of measuring operatives are not qualified in precision measurement for lack of systematic training programs of precision measurement

techniques for measurement-related manpower development. If the present circumstances go on, the supply of measuring technical labour will be much lower than the demand of measuring labour before long. At present, measurement-related education is provided only by training programs KRISS, KASTO, and the individual training courses of companies or organizations because any regular education organization for precision measurement is not established. It is expected that the demand of measuring manpower in industries will increase rapidly on account of the rapid growth of precision measurement-related activities in advanced industries. To meet this trend, therefor, education organization and training center to supply sufficient measuring manpower to industries should be established urgently.

6. It is observed that 48.8% of total industrial companies are equipped with a measurement standards laboratory. But the circumstantial conditions of their measurement standards laboratories are revealed to be insufficient to maintain the precision and accuracy of measuring instruments. About 41.9% of industrial firms with a measurement standards laboratory secures a room of less than 33㎡ for a standards laboratory and, what is worse, 75% of them with a standards laboratory has inadequate facilities of temperature and humidity.

7. Meanwhile, it is revealed that the average measurement-related investment of each company was only 96 million won (80,000 US$). Measurement-related investment is 216 million won (180,000 US$) in large scaled companies and 38 million won (31,700 US$) in small-medium scaled companies respectively. Measurement-related investment, which is the basic investment for the improvement of the quality of goods, includes purchasing expenditure of measuring instruments, expenses of calibration and testing, repairing cost, operating cost of measurement standards laboratory and so on.

8. It is observed that the defect rates of products in domestic industries is respectively 2.22%(1996), 1.84%(1998). Meanwhile, the rate of measurement-related defect of products is 0.05%(1998), which means 8 million won (6,700 US$) for each firm as the average amount of the measurement -related loss.

If we see the differences of the defects of products by manufacturing firms, the product defect is to be the least in firms with a measurement standards laboratory. Especially, the rate of the measurement-related defect of industrial

firms with a measurement standards laboratory decreased as much as 0.05% (point) of production cost as compared with that of industrial companies without measurement standards laboratory, which means measurement-related investment is closely related to the decrease of the defect rate products.

Ⅲ. Countermeasures for the improvement of measuring capability in Korean industry

In order for Korean industries to equip with the international competitiveness of product quality, the following steps should be preceded as the comprehensive strategy for the advancement of measuring capability.

1. Enhancement of concern and awareness of precision and accuracy control for the measuring instruments in manufacturers; The number of qualified testing and calibration organizations should be balanced by region, so that a variety of measuring instruments at industries could undergo timely testing and calibration services. In particular, financial benefits should be provided for purchasing measuring instruments.

2. Reinforcement of system and public relations on precision measurement technology support ; The precision measurement technology support has been established under certain circumstance and less systematic until now. So, KRISS must be center which support these technology to correspond to demand of precision measurement speedily and systematically. And we persevere in our efforts of inquiries of precision measurement technology demand and reinforcement of public relations on these support.

3. Establishment of "Technical College for Measurement" and "Standards Training Center" ; In order to produce competent technical workers for measurement, it is requested that "Technical College for Measurement" be established, and the "Standards Training Center" (tentatively named) should be created with a view to improving the management capability for measurement technology and enhancing the awareness of national standards. The center acts also to provide retraining opportunities for middle-class management, measuring specialists at site, and officials engaged in measurement, testing and calibrations.

4. Encouragement of publicity on measurement control and the government's

supports for the industries' investment for measurement; when systematic system is not properly applied, the operation and management of measurement control could give rise to a great deal of economic loss as well as product defects. Therefore, the environment of measurement control in industry should be improved.

An analysis on the defect rate of products in Korea industries show that the more positive investment on measurement control is related to the lower defect rate of product the industry has. It suggests that industries should organize a section exclusively responsible for standards and measurement control and the government should provide financial and taxation benefits for improving measurement environment and facilities.

In view of the improvement of precision measurement technology and the promotion of quality of products, measurement-related investment should be enlarged. It is expected that vitalization of industrial measurement-related investment and government's supports to precision measurement technologies will secure the international competitiveness of industrial technologies earlier. We can consider the followings as concrete policies ;

1) In the case of purchasing advanced measuring equipments to change superannuated equipments, financial supports and tax deduction should be provided to small and medium companies.

2) For the enhancement of measurement technologies of small subcontract firms, large corporations and research institutes provide the technological instruction.

3) Through the public lectures on the roles of measuring personnel and the significance of measurements, the recognition which measurement-related investment is closely related to the promotion of productivity and the decrease of product defects should be spreaded.

Ⅳ. Conclusion

The support of precision measurement technologies to industries in Korea began with the establishment of Korea Research Institute of Standards and Science (KRISS) in 1975. Before 1975, although the significance of precision measurement technology was realized, measurement standards were used only for commercial trades, not for science and technology.

The number of measuring instruments has increased greatly as compared with that of measuring instruments 10 and 20 years ago in domestic industries and grades of precision and accuracy in industrial measurements have been enhanced considerably through the technological supports to industries by Korea Research Institute of Standards and Science, other public and industrial calibration agencies. Also, the calibration rate measuring instruments has increased rapidly, which reflects that awareness of the importance of the precise measurements has been spread. (see table 4)

In conclusion, for the advancement of measurement technology in the 21th century as well as the promotion of international competitiveness of domestic products, it is recommended that, first, a regular junior college and training centers for measurement-related manpower be established in the near future. Second, measurement-related technical information should be imported and adapted. Third, calibration performance ratio should be increased to 90%. And fourth, measurement-related investment should be expanded for the advancement of measurement technology in public sectors as well as in private sectors. Finally, government authority should lead industrial companies publicly to establish the sections exclusively responsible for measurements so as to contribute to the promotion of international competitiveness of their products.

(Table 4) Change of measurement capabilities in Korea industries

Year / Classification	1977 (4,173 firms)	1989 (1,751 firms)	1999 (1,281 firms)
Number of calibration agencies	5	59	160
Percentage of calibration of high accurate instruments	37.8%	75.1%	82.5%
Number of measuring instruments calibrated by KRISS	1,891	9,544	24,021
Number of measuring instruments per manufacturing firms	58	200	395
Percentage of high accurate instruments	4.8%	10%	5.6%
Percentage of firms with standards laboratory	3%	18.9%	48.8%
Number of measurement-related trainees	46	991	847

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