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QUALITY INFRASTRUCTURE IN THE REPUBLIC OF KOREA

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TIPS report for the Department of Trade, Industry and Competition. This country study is for a project on the alignment of the quality infrastructure/technical infrastructure in South Africa. The project includes four country case studies: Australia, Brazil, Kenya and South Korea. The case studies are available on the TIPS website.

CONTENTS

ABBREVIATIONS

ANSI	American National Standards Institute (US)
APMP	Asia Pacific Metrology Programme
APLMF	Asia-Pacific Legal Metrology Forum
CIPM	International Committee for Weights and Measures
COSD	Cooperating Organisations for Standards Development
dtic (the)	Department of Trade, Industry and Competition (South Africa)
GDP	Gross Domestic Product
IEC	International Electrotechnical Commission
ISO	International Organization for Standardisation
KAB	Korea Accreditation Board
KAS	Korea Accreditation System
KASTO	Korea Association of Standards and Testing Organizations
KATS	Korean Agency for Technology and Standards
KC	Korea Certification
KOLAS	Korea Laboratory Accreditation Scheme
KRISS	Korea Research Institute of Standards and Science
KS	Korean Standards
KTC	Korea Testing Certification
LPG	Liquefied Petroleum Gas
MSIT	Ministry of Science and ICT
MKE	(former) Ministry of Knowledge Economy
MLA	Multilateral Recognition Arrangement
IAF	International Accreditation Forum
MOCIE	(former) Ministry of Commerce, Industry and Energy
MOTIE	Ministry of Trade, Industry and Energy
MSIT	Ministry of Science and ICT
NCSRD	National Centre for Standard Reference Data
NIST	National Institute of Standards and Technology (US)
NMI	National Metrology Institute
NMIJ	National Metrology Institute of Japan
ODA	Official Development Assistance
OECD	Organisation for Economic Cooperation and Development
PAC	Pacific Accreditation Cooperation
PTB	Physikalisch-Technische Bundesanstalt (Germany)
QI	Quality Infrastructure
R&D	Research and Development
SMEs	Small and Medium Enterprises
SRD	Standard Reference Data
TI	Technical Infrastructure
TBT	Technical Barriers to Trade
US	United States
WTO	World Trade Organization

1 INTRODUCTION

1.1 Motivation and terminology

The Department of Trade, Industry and Competition (the dtic) commissioned TIPS to conduct a study on the alignment of the Technical Infrastructure in South Africa. Part of this study is a comparison with other countries.

The research team selected the Republic of Korea/South Korea as one of the comparison cases. The selection was based on the fact that, in only a few decades, the country has transformed itself from a war-torn, backward agricultural country into one of the world's leading industrial nations. In this case study, the first step is to looks at the role of quality infrastructure in "the miracle of the Han River". At the same time, it looks at the current challenges of South Korea's quality infrastructure to adapt to new challenges.

In this study, the term "quality infrastructure" is used as currently promoted by international professional organisations. In South Korea, the term National Standard System is still used, which is comparable to the technical infrastructure (TI) in South Africa. In line with international usage, South Korea now also uses the term infrastructure and speaks of "National Standards Infrastructure" (Seo et al., 2013).

The term quality infrastructure implies an aspiration of the future of the system in which public and private organisations offer services within a clearly defined framework that promote quality, safety and environmental soundness of goods, services and processes. The quality infrastructure is based on metrology, standardisation, accreditation and conformity assessment. As a system, the organisations serve the effective operation of domestic markets, and their international recognition is important for access to foreign markets. Overall, QI serves to promote sustainable economic development, as well as environmental and social well-being.

1.1 Information base

The information situation on the quality infrastructure in South Korea is comprehensive. Various studies provide an overview of the development phases as well as the current challenges of the national standardisation system.

Key publications are:

- Choi, D.G. (2013). A Primer on Korea's Standards System: Standardization, Conformity Assessment, and Metrology. Washington DC: National Institute of Standards and Technology.
- Seo, S., Bahng, G.W. and So, H.Y. (2013). National standards infrastructure underpinning the economic growth of Korea. Knowledge Sharing Program: KSP Modularization.
- Yoo, H. (2019). A Case Study on the Establishment of a National Quality Infrastructure in Korea. 19th International Congress of Metrology (CIM2019). EDP Sciences.

The websites of the QI institutions provide detailed information, however, not all of the information is accessible to the English-speaking reader.

2 CONTEXT

South Korea, officially the Republic of Korea, is located in East Asia and forms the southern part of the Korean Peninsula. After the Second World War, Korea was divided into a Soviet zone and a United States (US)-administered zone. The latter became the Republic of Korea in August 1948. In 1950, a North Korean invasion started the Korean War. After the war ended in 1953, there was nearly nothing left behind in South Korea available for its economic growth. It was in the early 1960s that the country's economy began to step forward under the strong leadership of the government, which had worked out consecutive five-year economic development plans until 1996. In the 1980s, the country recorded the fastest gross domestic product (GDP) per capita growth in the world.

In the 1990s, the government began to implement economic liberalisation measures and reacted to international and domestic pressure to lift trade restrictions. This policy was in line with the global trade liberalisation that led to the establishment of the World Trade Organization (WTO). The more powerful industrial groups, the *chaebols*,[1] also supported this policy in order to be able to expand further. The accession of South Korea to the Organisation of Economic Cooperation and Development (OECD), which recognised its transformation to a leading industrial country, also falls within this phase.

Parallel to economic development, South Korea's political system underwent a fundamental change. Post-war development was marked by the military dictatorship under the leadership of the then President Park Chung-hee. He promoted close co-operation between politics and business and allowed large industries to develop. Under his leadership, South Korea transformed into an export-oriented industrial state, education was promoted, and the standard of living grew continuously.

In the summer of 1987, the authoritarian regime came to an unexpected end, and in November 1987 direct democratic elections were held for the first time since 1961. Since then, South Korea has developed into a liberal democracy. At the same time, the close ties between politics and large corporations has led to various corruption scandals, in the context of which, among others, former head of state Lee Myung Bak (2008 to 2013) was sentenced to prison (New York Times, 2018).

At the beginning of the 21st century, South Korea started undergoing an intensive structural change towards a knowledge economy. President Park Geun-hye (2013-2017) placed the promotion of the creative industries at the centre of her policy, which includes the promotion of an innovative business ecosystem around the *chaebols*. After her removal, human rights activist Moon Jae-in has been leading the country since May 2017. President Moon is putting much more emphasis on shared growth of the chaebols and small and medium enterprises (SMEs), with a view to helping SMEs gain market access and drive innovation. Consequently, the measures to mitigate the consequences of the COVID-19 crisis focus in particular on financial support and promotion of small businesses.

South Korea's QI, or National Standard System, has adapted during the various political-economic phases. At the beginning of the 1960s, Korean products were of low quality. This poor-quality image limited export possibilities and was an obstacle to industrialisation plans. This prompted the adoption the Industrial Standardization Act of 1961 and the start of building a national quality infrastructure.

At the beginning of the Korean Republic, the US supported the establishment of a National Metrology Institute with the help of the National Institute of Standards and Technology (NIST). The metrology and standards institutes of Germany (Physikalisch-Technische Bundesanstalt – PTB) and Japan (National Metrology Institute of Japan – NMIJ) were also essential supporters. Today, South Korea has one of the world's leading technical competence in various areas of quality infrastructure. In the era of industry 4.0, Korea's QI system faces the challenge of promoting promising fields of convergence technology more proactively and better integrating the innovative SME sector.

[1] A *chaebol* (literally rich family) is a large industrial conglomerate that is run and controlled by an owner or family in South Korea. Examples are companies such as Samsung, Hyundai and LG.

3 STRUCTURE AND GOVERNANCE

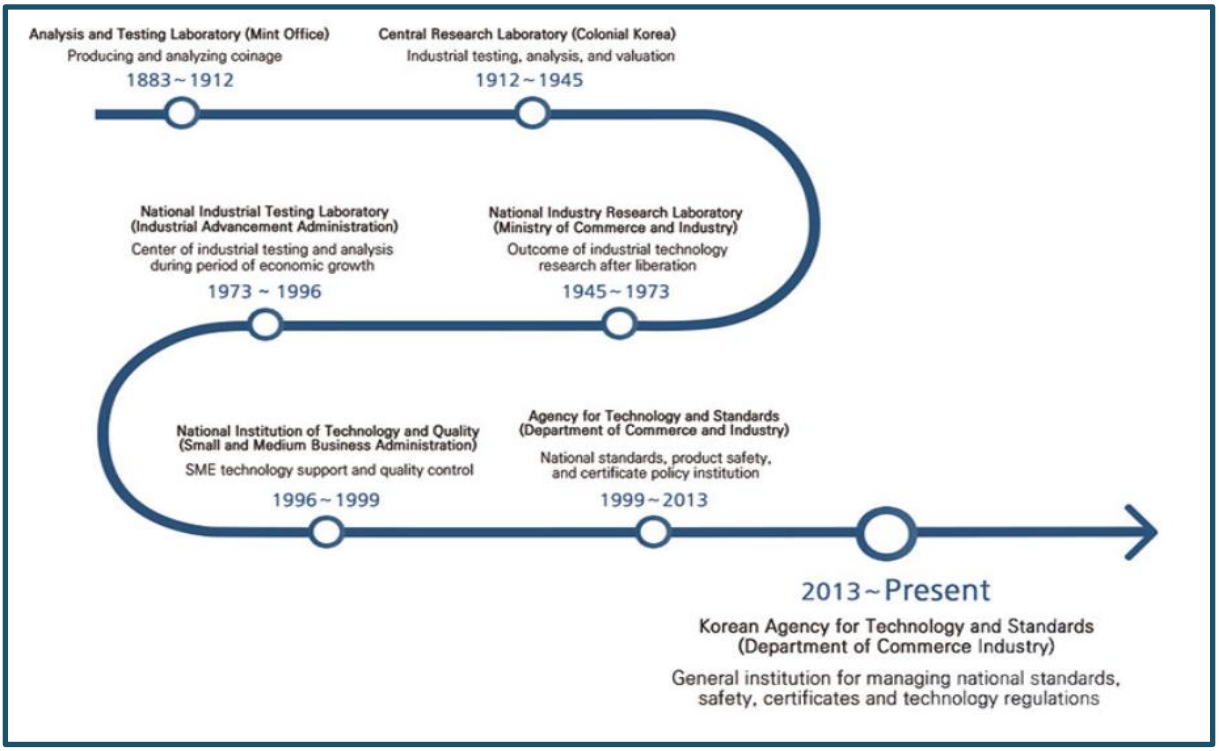
South Korea's quality infrastructure is based on three pillars: metrology, standardisation and conformity assessment, which includes accreditation.

In the following section , the leading organisations of the national quality infrastructure are presented individually. How the competences of these organisations are distributed between the areas is described, in particular the institutional division of labour in voluntary and mandatory tasks.

3.1 Korean Agency for Technology and Standards

KATS is the national standard body.[2] KATS was initially established in 1883 as the Analysis and Testing Laboratory under the auspices of the Mint Office, which was in charge of producing coinage as well as analysing, processing, and refining the metallic mineral (KATS, 2014a).

Figure 1: Timeline of KATS historic development



Source: From KATS website. History page. (KATS, 2014a).

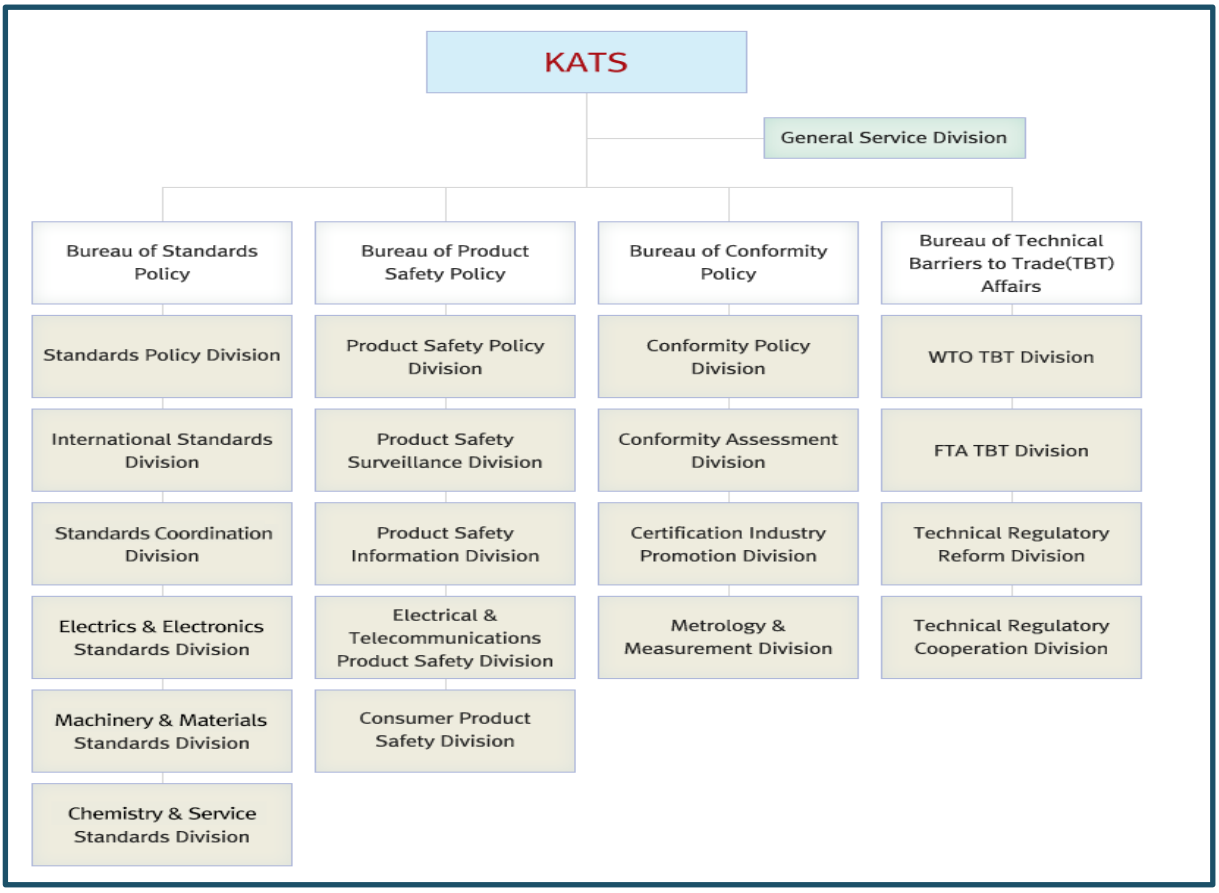
KATS mainly supported technology development and conducted testing, analysis and evaluation of consumer products under the Industrial Advancement Administration until 1996. However, later on, functions related to industrial criteria and quality safety of consumer goods were integrated into the organisation as affiliated with the Small and Medium Business Administration.

In 1999, as aligned under the Ministry of Commerce, Industry and Energy (MOCIE), KATS held the position of representative National Standardization Body in Korea, overseeing various activities, such as development of Korean Standards (KS); control of quality and safety of consumer products; operation of legal metrology system; management of technical evaluation; and certification of state-of-the-art technology and products.

In 2006, KATS strengthened policy activities in standards and product safety and reorganised towards a consumer-friendly and performance-based administration system.

[2] The following text is mainly based on information from the website www.kats.go.kr and the annual reports. See KATS 2019. Annual Report 2018. Standards for the 4th Industrial Revolution, Seoul.

Figure 2: Organisational chart of KATS



Source: From KATS website. Organization page. (KATS, 2014b)

KATS co-ordinates the national standards system and pursues the following objectives:

- To advance and innovate with the national standards system, including harmonising standards between North and South Korea.
- To strengthen the technology infrastructure of the standards system, and continuously improve the legal metrology system.
- To represent South Korea in international standardisation activities.
- To assist the private sector in increasing its capacity to develop standards (ANSI, n.d.)

KATS leads the establishment of Standard Basic Plans, Standards Development and Standards Promotion. KATS hosts the WTO/Technical Barriers to Trade (TBT) Enquiry Point and provides conformity assessment services.

3.2 Korea Research Institute of Standards and Science

KRISS is the National Metrology Institute (NMI) of Korea. The South Korean government established KRISS in the mid-1970s, during the formative stages of the nation's industrialisation, to represent Korea in the national and global metrology community and to perform all related duties. KRISS is one of the government-funded research institutes under the Ministry of Science and ICT (MSIT). As the NMI of Korea, it serves as South Korea's key research and development (R&D) institute committed to the advancement of metrology. KRISS also manages the National Centre for Standard Reference Data (NCSRD).

The reputation of KRISS relies on its scientific excellence. KRISS employs 489 people, including 298 research scientists, 121 technicians and engineers and 70 in administration. The operating units

of KRISS are organised into two research divisions mainly responsible for fundamental measurement standards and technologies, and four institutes engaged in R&D of cutting-edge applied measurement technologies. They are-supported by four divisions for service and management. Each division is made up of specialist centres dedicated to improving its measurement capabilities and services. The budget for 2019 amounted to US$156.65 million (KRISS, n.d.-a).

KRISS continuously invests in securing human resources, strengthening precision measuring equipment, and establishing an advanced quality management system. The government finances about 80% of the budget of KRISS (Seo et al., 2013).

KRISS has set up and been operating strategic R&D programmes so that its competent research scientists, both experienced and young, can make a commitment by carrying out R&D on forward-looking subjects across wide range of measurement science and technology. KRISS invests a significant amount of funding on an extended basis to provide measurement solutions for concerns on national and global agendas such as climate change, safety, health, food, energy, and the environment.

KRISS is internationally recognised for its world-class competence in metrology.[3] Based on the experience of Korea's growth as a nation and the KRISS as an NMI, this report is designed to share knowledge with developing countries on the national standards infrastructure underpinning the economic growth of Korea.

KRISS continuously conducts education and technology transfer to improve measurement capability of conformity assessment bodies, while metrology experts participate in the standardisation process. KATS works with KRISS experts in co-operation with international standardisation institutions and legal metrology organisations.

3.3 Korea Laboratory Accreditation Scheme, Korea Accreditation Board and Korea Accreditation System

There are three national accreditation bodies in South Korea:

- The *Korea Laboratory Accreditation Scheme* (KOLAS) is the government accreditation body established in 1992 and administered by KATS. KOLAS is responsible for the accreditation of laboratories for calibration, testing, inspection, and reference materials.
- The *Korea Accreditation Board* (KAB) is a non-profit organisation and responsible for the accreditation of management system certification bodies. KAB was established in 1995 in accordance with the government's policy of non-governmental operation for Quality and Environmental Management System certification.
- The *Korea Accreditation System* (KAS) is a national accreditation body established in 2001 within the framework of KATS, and the Administrator of KATS serves as the Head of KAS. KAS provides accreditation for product certification bodies in the fields of electric apparatus, gas appliances, renewable energy equipment, metals, ceramics, chemicals and plastics which are not subject to the current mandate. KAS joined Pacific Accreditation Cooperation (PAC) Multilateral Recognition Arrangement (MLA) in July 2007 and International Accreditation Forum (IAF) MLA in October 2007 for products.

All accreditation bodies operate under the Ministry of Trade, Industry and Energy (MOTIE).

[3] See Case Study on Collaboration of Legal and Scientific Metrology in South Korea. Available at: https://www.ptb.de/cms/fileadmin/internet/fachabteilungen/abteilung_9/9.3_internationale_zusammenarbeit/docs/APLMF_APMP_PTB_National_Metroligical_Infrastructure_01.pdf - p37.

4 KEY COMPONENTS AND DISTRIBUTION OF COMPETENCES

4.1 Metrology (scientific, industrial and legal)

The legal basis of the metrology in South Korea are the Measures Act of 1961 and the Framework Act on National Standards of 1999.

The objective of the Measures Act is to implement appropriate measurement practices that comply with metrology criteria (Standards Portal, n.d.-a). It covers mainly legal metrology activities and attributes the authority for legal metrology to KATS.

Main contents are:

- Legal metrology conforming to the international system of units.
- Type approval and verification for measuring instruments to ensure accurate measurement before the delivery of products.
- Self-declaration of conformity, items subject to pre-packaged products, allowable errors and labelling methods for pre-packaged products.

Under the Measures Act, measuring instruments are divided into two categories. The first category is measuring instruments for trade or certification purposes. There are 13 items (non-automatic weighing instruments, weights, gas meters, water meters, hot water meters, oil meters, fuel dispenser, urea water meters, liquefied petroleum gas **(**LPG) metres, graduated tanks, heat meters, electricity meters, and electric vehicle chargers). The second category is measuring instruments for measurement except for trade or certification. The two groups are the same in a sense that these instruments are machines, appliances or devices for measurement of the quantity of the state of physical phenomena.

In accordance with the Measures Act, KATS has the responsibility for the type approval, but has delegated the authority to the Korea Testing Certification (KTC). KTC carries out this responsibility by examining the designs of measuring instruments and testing sample instruments. Once the type of an instrument has been approved, KTC issues a certificate of approval and instruments made to the type must be marked with the KTC number contained in that certificate. The marking of this number on the instruments is the primary indication that the measuring instruments are of an approved type.

The Framework Act on National Standards articulates overall activities of measurement standards, standards reference materials and data. It established the conformity assessment system, including the operation of calibration laboratories.

Asia-Pacific Legal Metrology Forum (APLMF) estimate the number of people involved in legal metrology as follows:

- Ten officers in the Metrology and Measurement Division of KATS.
- Thirty officers involved in testing and type approval functions at KTC.
- Eighty engineers for verification at KTC.
- Approximately 200 local technical officers for verification and inspection at 16 local governments (APLMF, n.d.).

Within a national metrology system, KRISS works closely with KATS. While KRISS is the NMI, the Framework Act gives KATS responsibility for legal metrology. This situation requires effective co-ordination and close co-operation between the two key players of quality infrastructure of Korea: the

government-funded research institute KRISS, which has excellent scientific and technical capacity in metrology, and the government agency KATS, which has legal authority.

In its function as the NMI, KRISS is responsible for the establishment, maintenance and improvement of national measurement standards for length, time, and weight; development of new metrology; and assessment technologies necessary for advanced industries. KRISS also supports industrial metrology by calibration and testing of industrial measuring instruments, and the dissemination of certified reference materials. In addition, private calibration laboratories provide services in industrial metrology. The calibration laboratories prove their technical competence through accreditation by KOLAS.

KRISS has been providing a variety of technology service programmes for its customers in ways that promote dissemination of national measurement standards and technologies (KRISS, n.d.-b). The technology service programmes consist of R&D collaboration, technology transfers and commercialisation, and networking activities. These services are offered through open networks with thousands of customer organisations, which include industry, academia, and research institutes.

Specific KRISS programmes are:

- Hidden Champion Program: KRISS is supporting the Korean economy through a programme that provides stepwise plans to SMEs to overcome technical obstacles and facilitate manufacturing processes.
- Consulting on technical difficulties: KRISS offers to consult on technical problems related to measurement-related technology in the industrial sites.
- Home Doctor Program: In this programme KRISS specialists offer one-on-one customised support to SMEs, including on-site technical consultation, and hands-on training at KRISS.
- Technical consultation: Based on the experience of 250 experts accumulated over 30 years, KRISS provides technical consultation on measurements and calibration for more than 100 cases from industries, calibration and testing laboratories, and research institutes each year.
- Joint use of research equipment: KRISS seeks to relieve the financial burden and strengthen industrial competitiveness by sharing about 500 research devices with enterprises.
- Measurement Club: This is a network of measurement experts, industrial users, and equipment manufacturers with 6 000 members participating in 27 diverse club areas, such as pressure, X-ray diffraction, hardness, surface analysis, antenna and temperature-humidity (KRISS, n.d.-b).

The Measure Act also mentions the Korea Association of Standards and Testing Organizations (KASTO). KASTO was established in 1979 to ensure efficient operation of the national calibration service. KASTO serves to promote and disseminate metrology. It is also one of the designated training institutions for KOLAS.

4.2 Standards and technical regulations

4.2.1 National Standards System

The Constitution requires the state to establish a system of national standards. The Industrial Standardization Act of 1961 and the Framework Act on National Standards of 1999 define this mandate.

The objective of the Industrial Standardization Act is to enhance the competitiveness of Korean industry by improving the quality of mining and industrial products and services involving industrial activities and promoting the efficiency of production. The main contents are:

- The establishment of KS as the national standards of Korea and their development, revision, and dissemination.
- The operation of a KS certification scheme to enhance the quality of products and secure the safety of consumers.
- Any necessary harmonisation and simplification of significant mining and industrial products, parts or materials to ensure their compatibility.

The objective of the Framework Act on National Standards is to provide basic requirements that are required to establish the national standards system, which are:

- The deliberation and adjustment among Korean government ministries of matters relating to standards.
- The harmonisation of KS, information and communication standards, measurement standards and technical regulations with international standards.
- The establishment of a conformity assessment system.

4.2.2 Korean Standards

The standardisation process in Korea follows the basic principles for standards development outlined by the International Organization for Standardization (ISO), the International Electrotechnical Commission (IEC), and the WTO TBT Agreement (Standards Portal, n.d.-b).

KATS oversees the development of Korean industrial standards (KS) (Standards Portal, n.d.-b), co-ordinating input from stakeholders in both the public and private sectors through its technical committees. Generally, KS are voluntary, meaning the government does not require compliance with them to place a product in the Korean market. However, KS is frequently referenced in government regulations and technical specifications and implemented by public agencies in procurement. For example, Korean government ministries reference about 19 000 KS in over 106 types of laws and regulations.

The KS certification scheme provides government agencies, local governments, government investment corporations and public organisations with the benefit that they can preferentially purchase products and services by KS-certified companies through Article 25 of Industrial Standardization Act.

Certification in green industries, such as LED lighting, has started recently and has been extended to information technology, shipbuilding, and aerospace industries. KS certification is also looking for ways to play its role anew vis-a-vis safety, environment-friendliness, social responsibilities, enhancement of energy efficiency, and consideration of the aged and the disabled, which are emerging as social issues.

The Korea Certification mark (KC Mark) was introduced as one single mark to integrate and unify all 13 existing legally compulsory certification marks. KC Mark may reduce the number of standard certification audit systems from 20 to nine, based on international standards (ISO/IEC Guide 67). The Ministry of Knowledge Economy (MKE) introduced the KC Mark system on 1 July 2009, and the systems were implemented on 1 January 2011, with the participation of other responsible ministries.

Today, there are more than 20 000 KS. In addition to KS, many other types of standards are used in Korea, including those developed by ISO, IEC and other international standards developers; regional standards; foreign national standards; and others (Standards Portal, n.d.-b).

4.2.3 Cooperating Standards Developing Organisations

The national standardisation system is becoming more market-driven and bottom-up, allowing standards users to drive standardisation activities. KATS has begun designating COSDs, which participate in developing national standards and strengthening the capability of the private sector to expand their role in the standards development process.[4] The national standards policy envisages increasingly transferring the responsibility for standards development and management to the private sector.

4.2.4 Technical regulation

The responsibilities for technical regulation are spread across numerous ministries. The basis for each is its own laws. Table 1 lists the most relevant regulatory authorities and their regulatory areas.

Table 1: Competent authorities for technical regulations

REGULATOR	SCOPE	LEGAL BASE
Korean Agency for Technology and Standards (KATS)	Electrical appliances subject to safety certification	Electrical Appliances Safety Control Act
	Consumer products subject to safety certification	Quality Management and Safety Control of Industrial Products Act
	Consumer products subject to self-safety confirmation	Quality Management and Safety Control of Industrial Products Act
	Consumer products subject to Child-resistant packaging	Quality Management and Safety Control of Industrial Products Act
	Elevators	Manufacture and Management of Elevators Act
	Type approval	Measures Act
	Type certification	Aerospace Industry Development Promotion Act
Ministry of Commerce, Industry and Energy (MOCIE)	LGP safety	L.P. Gas safety and Business Management Act and High-pressure Gas Safety Control Act
	Energy Efficiency	Energy Use Rationalization Act
Ministry of Land, Transport and Maritime Affairs	Mechanical parking equipment	Parking Lot Act
	Firewall and interior materials	Building Act
	Construction Machinery	Construction Machinery Management Act
	Floor-crashing sound isolation structure	Housing Act
	Lifeboat	Ship Safety Act
	anti-pollution equipment	Marine Environment Management Act
	Motor vehicles	Automobile Management Act
	Aircraft and dangerous goods packing	Aviation Act
Korea Communications Commission Radio Research Agency	Electrical communication equipment and materials	Framework Act on Telecommunications
	Radio and information technology equipment	Radio Waves Act
Ministry of Employment and Labor	Harmful or hazardous equipment	Industrial Safety and Health Act
Ministry of Environment	Water purification equipment	Management of Drinking Water Act

[4] For a list of COSD see https://www.standardsportal.org/usa_kr/e/resources/COSD_directory.aspx.

	Environmental measurement equipment	Development of and Support for Environmental Technology Act
	Car noise	Noise and Vibration Control Act
	Gas discharged from cars	Clean Air Conservation Act
Ministry of Culture, Sports and Tourism	Stage equipment	Public Performance Act
Ministry for Food, Agriculture, Forestry and Fisheries	Livestock products	Processing of Livestock Products Act
National Emergency Management Agency	Fire extinguishing equipment	Installation, Maintenance, and Safety Control of Fire-Fighting System Act
Ministry of Health, Welfare and Family Affairs Korea Food and Drug Administration	Pharmaceuticals	Pharmaceutical Affairs Act
	Functional cosmetics	Cosmetics Act
	Food	Food Sanitation Act
	Medical devices	Medical Appliances Act
	Health functional food	Functional Foods for Health Act

Source: Author based on https://www.standardsportal.org/usa_kr/e/resources/regulatory_agencies.aspx

In the context of its membership in the OECD, South Korea has made considerable efforts in the regulatory field in recent years (OECD, 2018). In 2013, the government set up a Technical Regulatory Reform Task Force. The aim is to introduce Good Regulatory Practices.

The regulatory reform should solve the following problems:

- Excessive regulation through rules that are difficult to implement.
- Multiple certifications due to overlapping regulations.
- Divergent regulations from international standards, which unnecessarily increase transaction costs for companies.
- Outdated regulations that no longer meet modern requirements (KATS, 2017).

With WTO-relevant regulations, KATS assumes a co-ordinating function. The responsibility for the technical regulations remains with the individual ministries. However, KATS carries out a Technical Regulatory Impact Assessment as part of a prescribed Preliminary Review. An ex-post-evaluation of the Technical Regulations is required.

5 CO-ORDINATION AND COMMUNICATION MECHANISMS

5.1 Policy framework

“Korea is considered to have a relatively public-sector-led and legislation-based standards system, as many of newly developed countries and developing countries do, while many developed countries including the US have more private-sector-led or less legislated systems” (Choi, 2013: 1).

In Korea, the Constitution stipulates that “the state establishes a national standard system”. Under the Constitution, the Framework Act on National Standards was enacted in 1999 as a practical law to establish a national standard system, i.e. national quality infrastructure.

The Framework Act refers to the components necessary for national quality infrastructure – such as metrology, standardisation, conformity assessment – and refers to harmonisation among these components. The Industrial Standardization Act, which was first enforced in 1961, provides the legal basis for the standardisation activities and conformity assessment activities in Korea (Seo et al., 2013).

Table 2 provides an overview of the central laws of South Korean quality infrastructure. The Framework Act on National Standards sets the scaffolding for the current overall system. The

Industrial Standardization Act defines the areas of standardisation and technical rules. The Measures Act describes the legal metrology. The other laws refer to technical rules and conformity assessment in specific areas. Also, there are the laws and regulations of the ministries that are also responsible for technical regulation and market surveillance.

Table 2: Legislation of the Korean standard system

Law	Year	Scope[9]			Short description
		ST	CA	ME	
Framework Act on National Standards	1999	○	○	○	management and coordination of national standards system
Industrial Standardization Act	1961	○	○		national standards (KS) development and conformity assessment (product quality)
Measures Act	1961			○	legal metrology
Quality Control and Safety Management of Industry Product Act	1967 (2000)		○		conformity assessment (product safety and management systems)
Electrical Appliances Safety Control Act	1974		○		conformity assessment (electrical product safety)
Framework Act on Product Safety	2010		○		management and operation of national product safety system

Source: (Choi, 2013: 3). *Note:* ST represents standardisation sector; CA represents conformity assessment sector including accreditation, certification, testing, inspection; and ME represents metrology sector.

5.2 Role of the lead ministries

The political leadership of the South Korean quality system is in the hands of the Ministry of Trade, Industry and Energy. The Ministry began in 1948 as the Ministry of Commerce in the First Republic. In 1993, the Ministry of Trade and Industry was merged with the Ministry of Energy and Resources (MOTIE, n.d.). The Ministry was reorganised in 1998 as the Ministry of Commerce, Industry and Energy after the new Kim Dae-jung administration transferred its role in trade policy to the Ministry of Foreign Affairs and Trade.

In 2008, the Lee Myung-bak administration launched the Ministry of Knowledge Economy integrating critical parts of the former Ministry of Commerce, Industry and Energy, Ministry of Information and Communication, and Ministry of Science and Technology. MKE helped the nation become a knowledge-based economy by reinforcing traditional industrial strengths while developing new growth engines. After taking office in 2013, President Park Geun-hye restored MKE's trade policy role, renaming it the Ministry of Trade, Industry and Energy. Now better equipped to deal with the challenges of the 21st century, MOTIE is committed to providing a foundation for economic growth by combining its efforts to fulfil its wide range of responsibilities in the areas of commerce, investment, industry, and energy.

The Ministry of Trade, Industry and Energy supervises the National Standards Body (KATS) including its functions in the field of technical regulation and legal metrology as well as the three accreditation bodies (KOLAS, KAB and KAS).

The National Metrology Institute is subordinate to MSIT. KRISS is one of 44 affiliated organisations of the Ministry.

5.3 Co-ordination

South Korea does not have a National Quality Council in which the interested parties co-ordinate their activities. It was not possible to detect any formal involvement of the private sector in the strategic management of the quality infrastructure.

5.4 Quality infrastructure intelligence

South Korea faces the challenge of redefining its development model. In recent decades, the country has been successful in adopting international standards and best practices. Today, South Korean companies are world market leaders in various fields and must set standards themselves (Choi et al., 2014: 969). This new position requires the institutions of the National Quality Infrastructure to act proactively. The intelligent and strategic use of data is also central to reach this goal.

A valuable resource is managed by NCSRD in KRISS. To store, retrieve, and digest vast quantities of data is of great interest with the increased need for scientific and technical data along with the remarkable growth of industry. Also, the demands of reliable and accurate data have increased significantly. Advanced countries have long archived and distributed data that are evaluated on accuracy and reliability and authorised by the government. These activities are strengthening the international competitiveness of the industry.

For keeping pace with advanced countries the Standard Reference Data (SRD) for the semiconducting industry, in particular physical and chemical property data of plasma, are key for developing semiconducting devices and semiconductor production technology. With these demands of reliable and accurate data, NCSRD is developing and distributing SRD to strengthen the international competitiveness of the industry (Kim, et al. 2009).

5.5 Regional and international Co-operation

Today South Korea is one of the technical leaders in various areas of quality infrastructure.

The outstanding and broad competence in the field of metrology is demonstrated by the participation in all 10 Consultative Committees of the International Committee for Weights and Measures (CIPM).[5] KRISS has succeeded in forming a global network of co-operation. For promoting its global partnerships in international metrology community, KRISS set up its strategic approaches by classifying its partners into three groups: international metrology organisations, advanced metrology institutes, and the NMIs of developing countries. This is to promote its global partnership activities to be more effective in sharing the benefits of shared efforts with those partners.

KRISS has taken up significant posts, serving as chair of major international metrology organisations such as the Asia Pacific Metrology Programme (APMP) and CIPM. To take the lead in the global community needs harmonised efforts by individuals and the institute. First, individual researchers are recognised for their excellent achievements in the subject field of metrology. Also, they are cultivated with the qualifications required to be leaders in the global metrology community. Then, the institute need to support potential leaders so that they can continuously participate in the activities of international metrology organisations.

[5] The CIPM currently has 10 Consultative Committees: Consultative Committee for Acoustics, Ultrasound and Vibration, for Electricity and Magnetism, for Length, for Mass and Related Quantities, for Photometry and Radiometry, for Amount of Substance: Metrology in Chemistry and Biology, Ionizing Radiation, for Thermometry, for Time and Frequency, and for Units.

KATS is an active member of APLMF. KATS represents South Korea in numerous ISO and IEC standards committees and thus participates in the development of international standards. The technical competence in conformity assessment is underpinned by the signing of Mutual Recognition Agreements of the accreditation bodies.

South Korea is an active member in all regional organisations for metrology, standards and accreditation in the Asia-Pacific region and on the international level. South Korea also regularly hosts the annual meetings of these organisations.

In South Korea, there is also a great need to give something back for the international help received in building the quality infrastructure. Thus, South Korea is actively involved in Official Development Aid in the Asia-Pacific region and worldwide. Together with United Nations Industrial Development Organization and others, South Korea supports the development of quality infrastructure in less developing countries.

To boost co-operation with developed countries, KRISS set its goal of strengthening strategic partnership in R&D activities. Notably, it has beefed up joint studies with national metrology institutes of advanced countries to develop technologies concerning the environment, health, safety and food for sustainable global growth. In this context, it is essential to specialise in the areas in which its partners show strength, such as co-operation in nanotechnology with the US NIST, the frequency standards of the next generation with the Japanese NMIJ, medical instrumentation with the German PTB, and food safety systems with the British Laboratory of the Government Chemist. It is also necessary to enlarge the scope of co-operation and research by expanding partnership with academia and research laboratories which have outstanding capabilities in the relevant R&D activities.

South Korea joined the OECD's Development Assistance Committee in 2010 and has accelerated its engagement and investment in Official Development Assistance (ODA) activities across broad sectors, including science and technology. Metrology has been regarded as having great potential to be Korea's representative ODA programme in science and technology. This is because metrology serves as the core infrastructure underpinning the sustainable economic growth of developing countries.

6 CONCLUSIONS

The development of South Korea shows how an underdeveloped country can build world-class quality infrastructure in a few decades. In the initial phase, state support was essential for developing QI institutions. From the onset, the government saw QI as central institutions for the export-led industrialisation model.

Publications on the history of South Korean QI emphasise the importance of technical support for QI institutions from advanced industrialised countries (US, Japan, Germany and the United Kingdom). Many Korean experts received their training in these countries or participated in exchange programmes. Based on these experiences, South Korean QI institutions are now committed to transfer their knowledge to developing and emerging countries. Quality infrastructure issues are part of the portfolio of the Official Development Aid of South Korea.

The case of South Korea shows that the quality infrastructure had to adapt continuously to the internal development of the country as well as to the international framework. The structures of the quality infrastructure are still characterised by the strong role of the state. There are also far closer relationships between QI institutions and large corporations than with SMEs. Accordingly, current reform efforts are aimed at giving the innovative private sector a stronger role.

KATS, the National Standards Body, is in the process of increasingly delegating its standard development competencies to COSDs. At the same time, KATS is taking on a stronger role in co-ordinating technical regulation and introducing good regulatory practices. Nevertheless, the processing of standards and technical regulations under one roof is seen by some as problematic, as there is a danger that the work of the standards committees will be too focused on supporting technical regulations. This is particularly worrying from the point of view of the private sector and its interest in voluntary standards.

In the field of metrology, KRISS limits itself to its function as NMI. KRISS has a strong scientific orientation and reports to the Ministry of Science and ICT. Legal metrology is the responsibility of KATS, which is under the Ministry of Trade, Industry and Energy. Despite this institutional separation, both institutions declare that they co-operate productively. This interface should be looked at in more detail.

The South Korean accreditation system is fragmented with three organisations. KOLAS, KAB and KAS are responsible for the accreditation of laboratories and inspection bodies, the product certification bodies and the quality management certification bodies respectively. Even though the division of tasks is clear, this model contradicts the approach of an accreditation body per country. Moreover, KOLAS is part of KATS, which can lead to conflicts of interest.

In this study, only an overview of the development and structure of QI in South Korea could be given. For a deeper understanding of the institutional dynamics, it will be necessary to enter into a direct exchange with the actors of South Korean QI institutions. This study provides an informative baseline.

As in many developing and emerging countries, the public sector dominates the Korean standards system. The Korean National Standards Plan aims to transform the public sector (government)-led system into a balanced public-private system for national standards. The challenge is to find workable mechanisms of a public-private co-operative system without affecting the current well-functioning processes within the established government-led national standardisation system. The balanced public-private system may require more private sector capacity than they currently have – more experienced and more capable organisations for standard development and for testing laboratories in testing and inspection than they have today.

The national standards system has provided a scientific and technological foundation for industrial development and increased exports to support South Korea's economic growth.

Although Korea's national administration system concerning standardisation is in the transition towards a public-private balanced system, it has still been more public-sector led or legislation-based, similar to most developing and newly developed nations, unlike in the case of the developed economies in Europe and North America. The difference may have originated from its history and from the stage of industrialisation of each country (Choi, 2013).

6.1 Inspirational Lessons from Korea

Some of the lessons that can be drawn from the Korean experience for South Africa include:

- The contribution of the National Quality Infrastructure in Korea to supporting the industrialisation of the country, and the dynamic approach to shifting the role and focus of the institutions in line with changing market conditions.
- The extensive use of Korean Standards in government regulations and technical specifications, and implemented by public agencies in procurement. For example, the Korean government ministries currently reference about 19 000 KS in more than 106 types of laws and regulations.

- That there is one KC Mark, introduced in 2009 as the single Korea Certification market to integrate and unify all 13 existing legally compulsory certification marks.
- The role of the National Quality Infrastructure to proactively support Korean firms with changing standards requirements as technology changes, and Korean firms move from adopting international practices to becoming industry leaders; and the intelligent and strategic use of data to support this role through the National Centre for Standard Reference Data.
- The manner in which the global engagements by the Korean National Quality Infrastructure supports both development of capabilities within the country and on global platforms for both individuals and institutions, including support for developing countries.

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