Global Metrology Academy in Brief

- HUMAN RESOURCES IS THE KEY! -

November 6th, 2014

Sangwook Seo
swseo@kriss.re.kr

GMA

KRISS Korea Research Institute of Standards and Science

KRISS

1 **KRISS at a Glance**
- national metrology institute (NMI) of Korea

2 **Partnership with Industry and Academia**
- Measurement Clubs, Home Doctors, Technology Transfer
- Metrology Research Centers (MRCs)

3 **Government Role in Advancing S&T and Metrology**
- for sustainable economic growth: case study for Korea

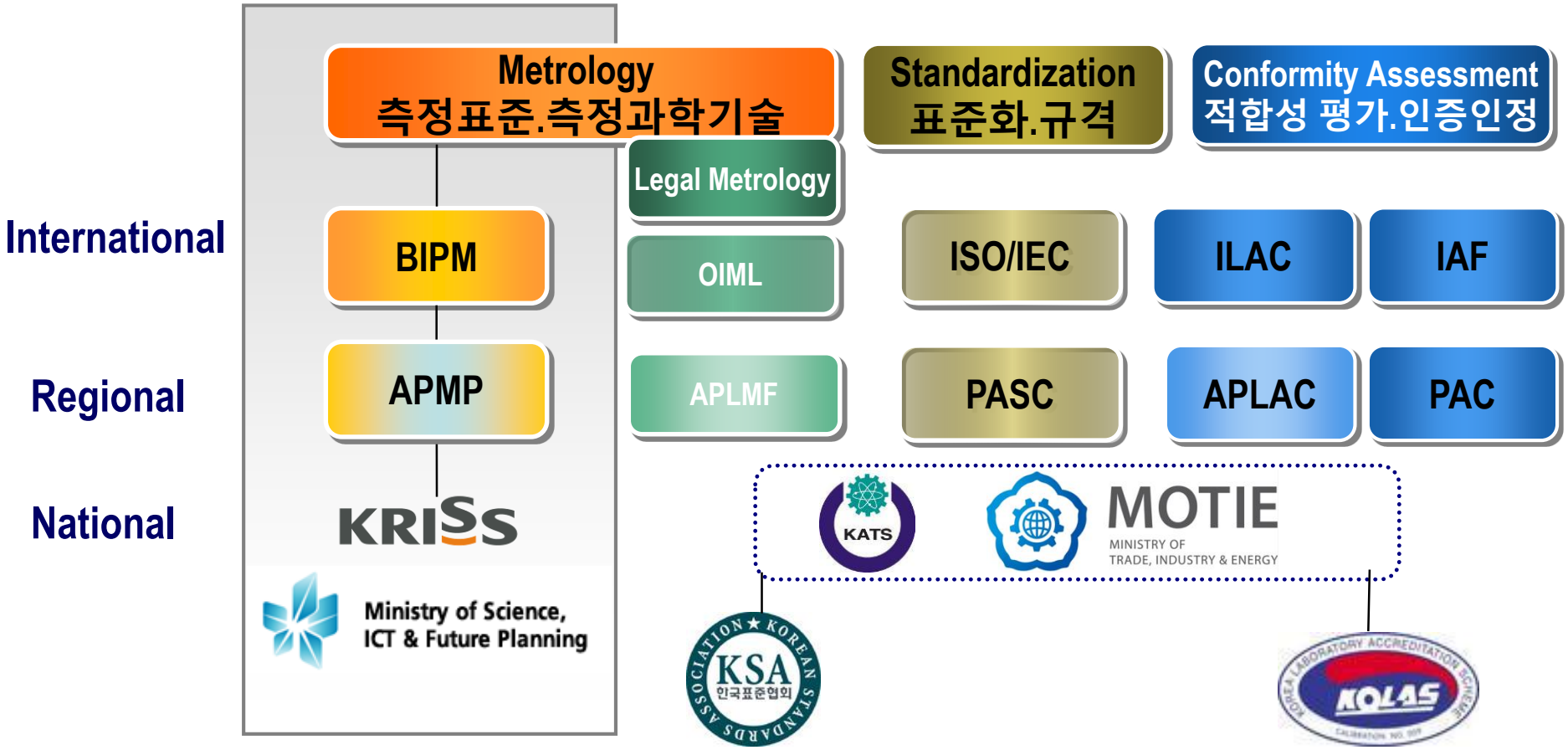
4 **GMA in Brief**
- achievements and plan

5 **Lessons Learned**
- and recommendations

KRISS at a GLANCE

KRISS Korea Research Institute of Standards and Science

National Standards System in Korea

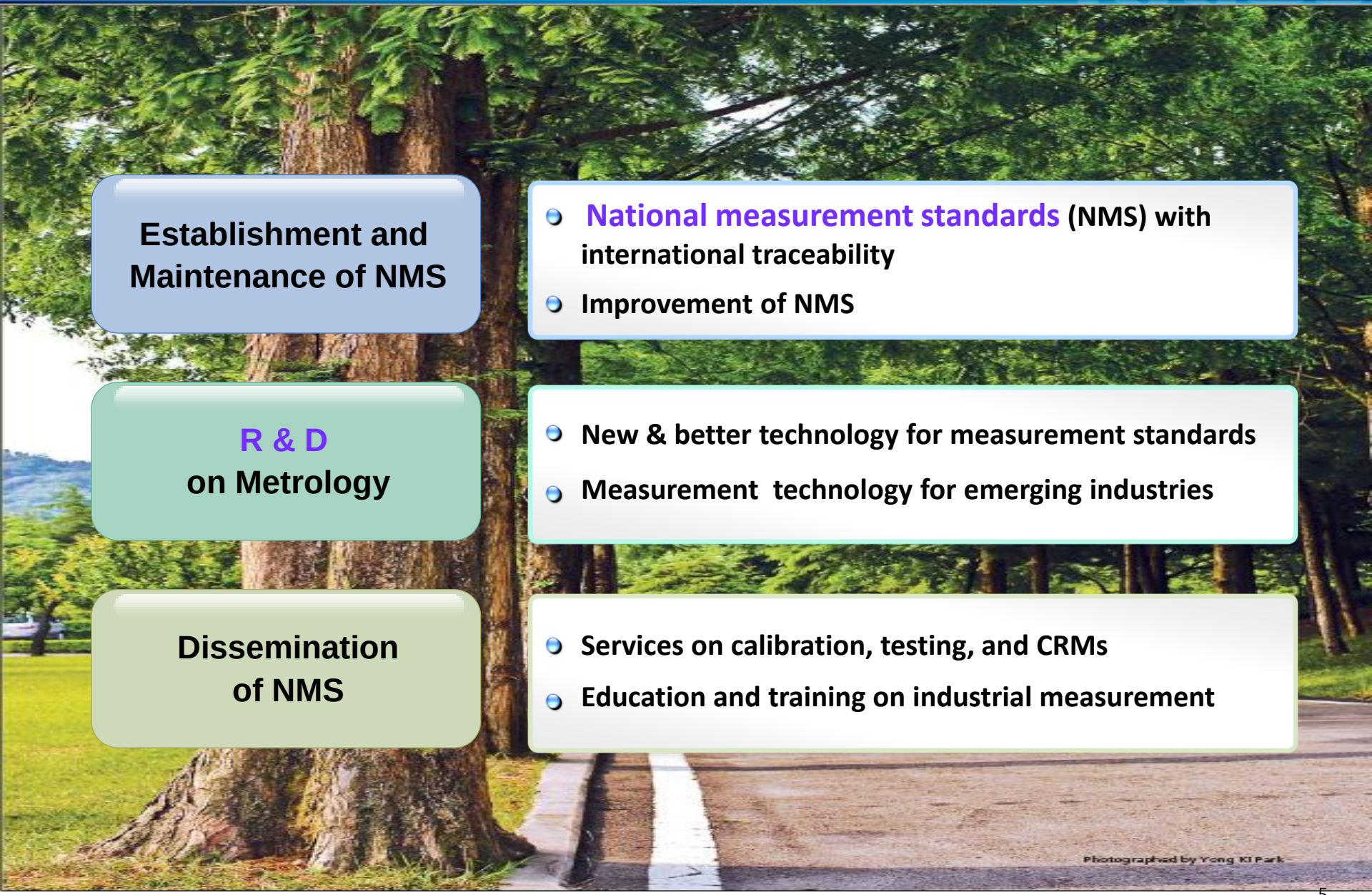


Promoting close and effective linkages among the organizations engaged in different areas of national standards system

APMP	Asia Pacific Metrology Program	ILAC	International Laboratory Accreditation Scheme
PASC	Pacific Area Standards Congress	IAF	International Accreditation Forum
APLMF	Asia Pacific Legal Metrology Forum	PAC	Pacific Accreditation Cooperation
APLAC	Asia Pacific Laboratory Accreditation Cooperation		

MISSION & MAIN FUNCTIONS

KRISS



Establishment and Maintenance of NMS

- **National measurement standards** (NMS) with international traceability
- Improvement of NMS

R & D on Metrology

- New & better technology for measurement standards
- Measurement technology for emerging industries

Dissemination of NMS

- Services on calibration, testing, and CRMs
- Education and training on industrial measurement

BRIEF HISTORY OF KRISS

Jun 2014 — Affiliated with National Research Council of Science & Technology (NST) under the Ministry of Science, ICT and Future Planning (MSIP)

Mar 2008 — Affiliated with Korea Research Council of Fundamental Science and Technology under the Ministry of Education, S&T

Feb 1999 — Officially designated by law as NMI of Korea
Framework Act on National Standards

Oct 1991 — Renamed as KRISS
Korea Research Institute of Standards and Science

May 1979 — Began Calibration Services

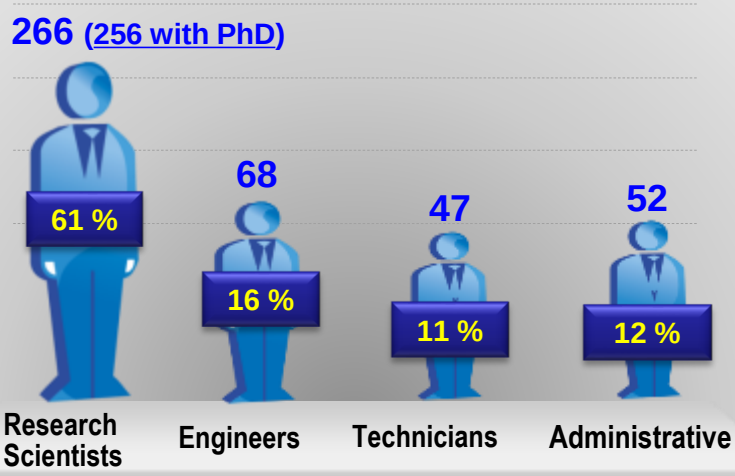
Dec 1975 — Established as KSRI
Korea Standards Research Institute

RESOURCES: HUMAN & FINANCIAL

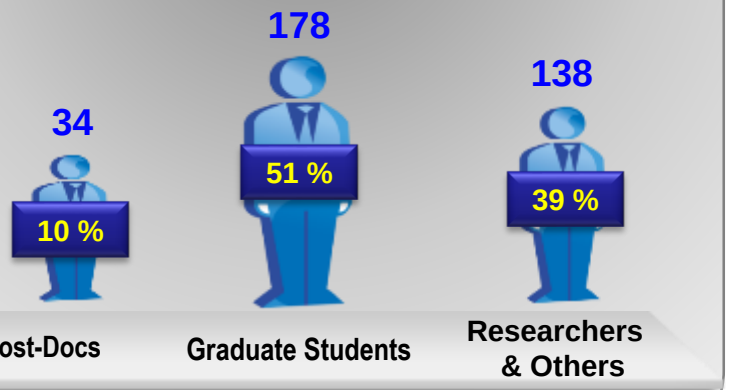
KRISS

Human Resources (Dec 2013)

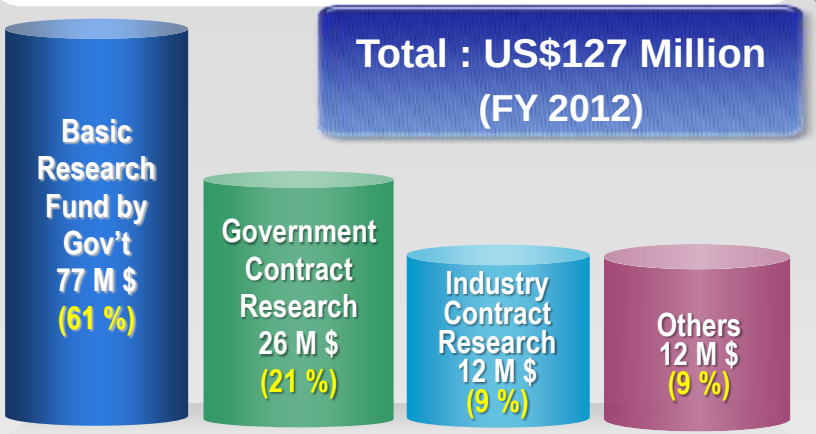
- **Permanent Staff: 433**

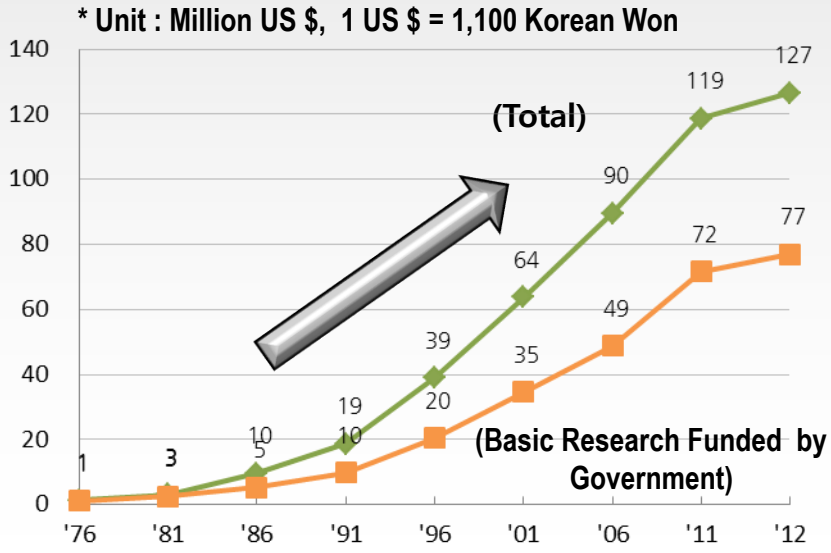


- **Temporary on contract: 350**

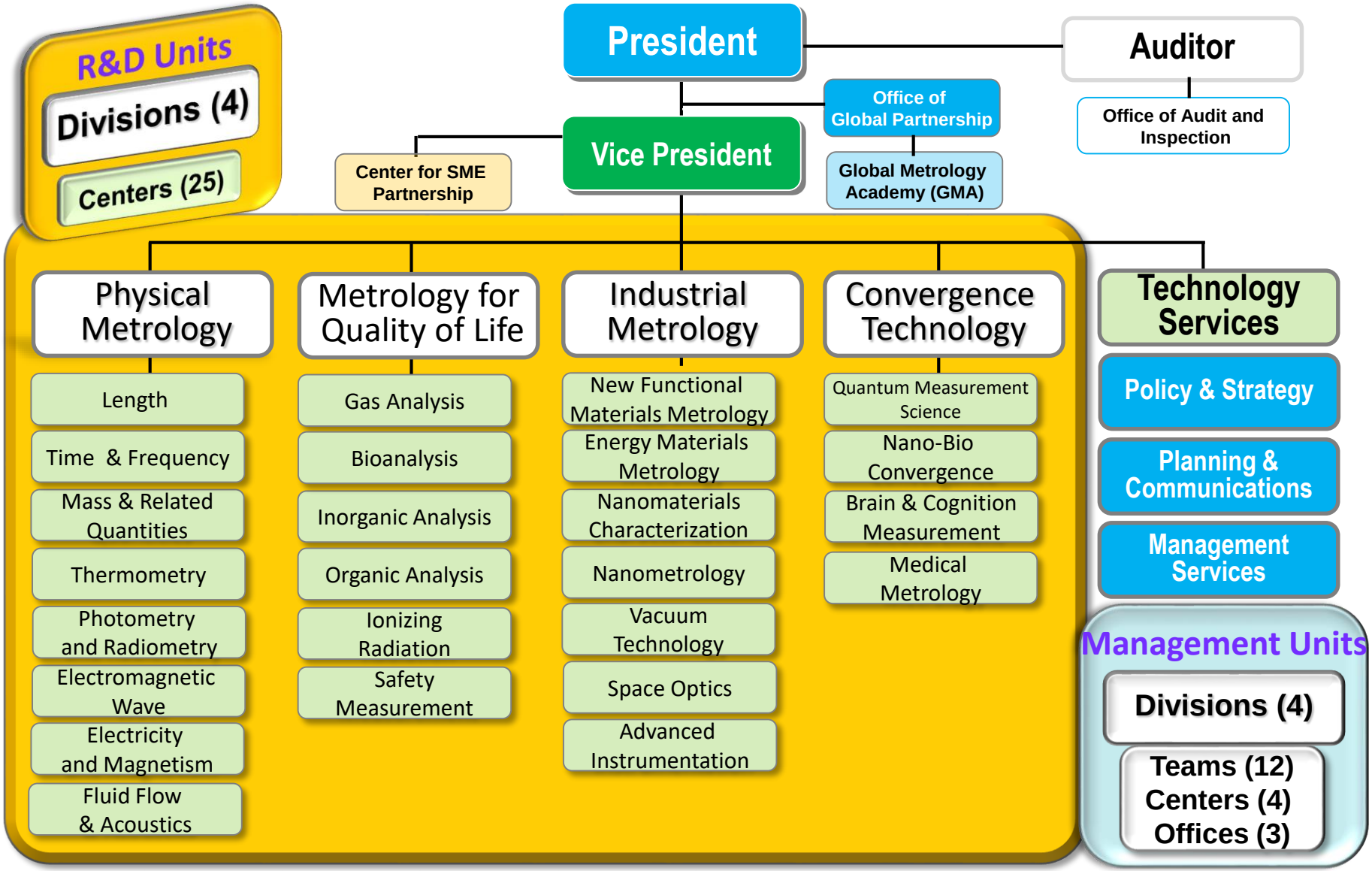


Financial Resources (FY 2012)





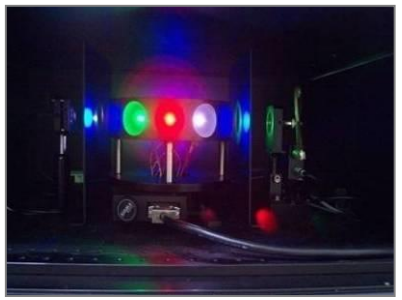
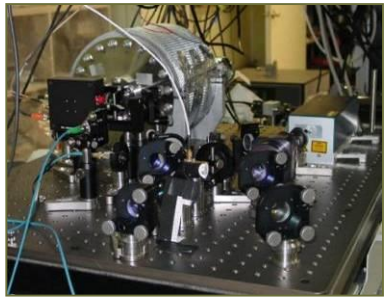
ORGANIZATION CHART



"Vision: one of the global leading NMIs"

- **Establish and improve measurement standards**
  - Participation in 373 items of Key Comparisons
  - Registration of 1139 items of CMC's
    (BIPM KCDB http://kcdb.bipm.org/ Feb 2014) ➔ *world-leading capability in metrology*
- **Recognized performance in fundamental physical metrology**
  - Length, Time/Frequency, Mass and Related Quantities, Thermometry/Humidity, Photometry/Radiometry, Electricity, Fluid Flow, Acoustics/Vibration, etc.
- **R&D on next generation measurement standards**
  - Atomic fountain frequency standard ➔ *redefinition of "second," unit of time*



"KRISS, working towards better standards for better quality of life"

- **CRM Development for Better Life: Food/Environment/Medical Care**
  - **Measurement standards for the environment and food**
    - **International equivalence of the environmental measurement**
    - **Top quality standards for greenhouse gas measurement**
    - **Food CRMs for measurement of environmental radioactivity**
    - **Developed 277 items of environmental CRMs, 27 items of clinical CRMs**
- **Significance of CRM Development: solutions to the global issues**
  - To cope with **climate change** by measuring CO_2, N_2O, CH_4 gases
  - To ensure the **food safety**: Radioactivity measurement on rice
  - To promote **health conditions**: Toxic substances (Phthalate) measurement in toys and medical devices

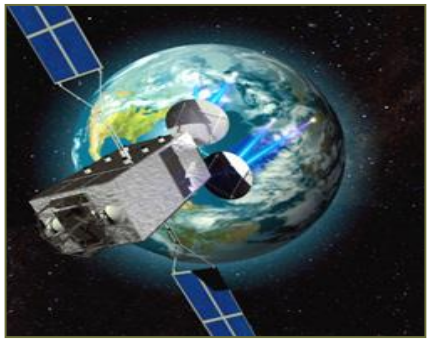
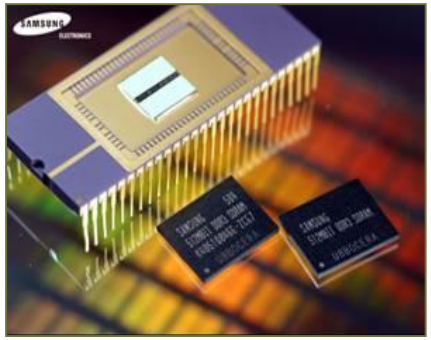





759 items of KRISS CRMs

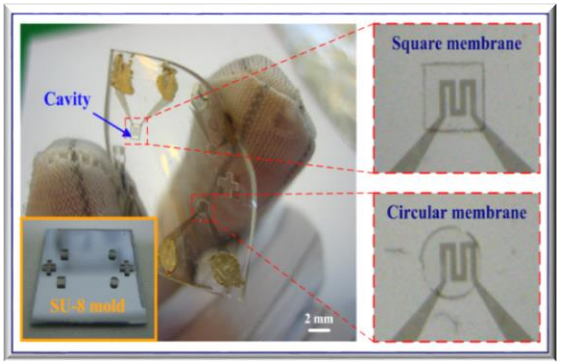
"KRISS, exploring cutting-edge industrial technology"

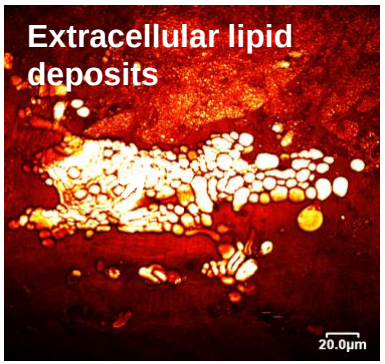
- **Cutting-edge measurement technology** to enhance the global competitiveness of industries, such as:
  - space optics, vacuum, advanced instrumentation, etc.
- **Total measurement solutions** for safety and security in energy sectors
- **Measurement technologies** for public safety
- **Measurement capabilities** in the fields of nano-materials

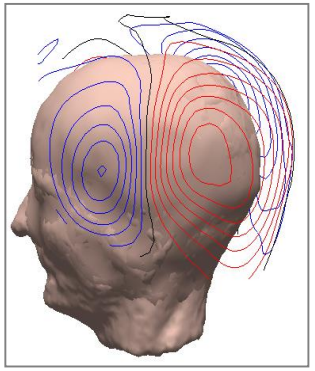



"KRISS, studies on future and convergence technologies"

- SI traceable single **quantum-based standards** for current, force, noise thermometry, and optical lattice clock
- **Technologies for a precision measurement** based on quantum mechanical nature of micro/nano scale system
- **Nano-bio technology** for label-free, real time, and biochemical imaging
- **Brain and Cognition Measurement**







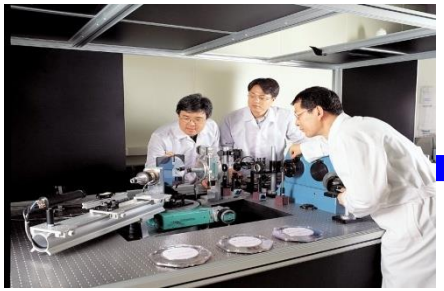
PARTNERSHIP WITH INDUSTRY

MEASUREMENT SOLUTIONS FOR IT INDUSTRY

- Thin-film thickness: Key metrological challenge in Semiconductor Industry

KRISS provided solutions by developing CRMs

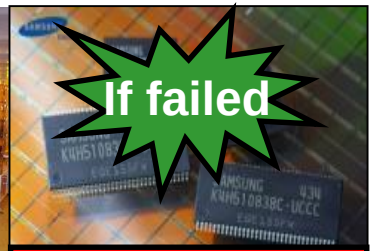
- Target thickness: 0.6 nm / Process tolerance: < 0.024 nm (3σ) / Precision: 0.0024 nm (3σ)



Using KRISS High-Accuracy Spectroscopic Ellipsometer

Developed KRISS CRM for measuring thin-film thickness

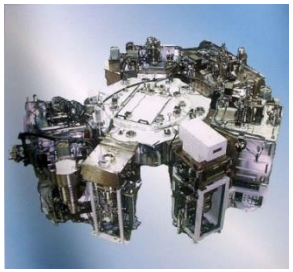
Used for Calibration of Ellipsometers used in Thin-film Processes



Loss of tens of million dollars

- **Vacuum processing in Display industry**

➔ Key role in quality control, process innovation, productivity improvement



Vacuum Process in Fab. : 80 %

Korea Vacuum Market Value: > $ 60B/year (ave. 8 % of world wide)

For SAMSUNG Electronics

MEASUREMENT SOLUTIONS FOR AUTOMOBILE INDUSTRY

KRISS

- **Torque control in Automobile assembling**
  - Key role for automobile quality control

Bolting occupying
90 % of Engine Assembling

- **Accurate Torque Measurement - Producing world best vehicles**

Torque standards in KRISS
(0.005 %)

Torque calibration machine
(0.1 %)

Torque wrench
(1 %)

World class car

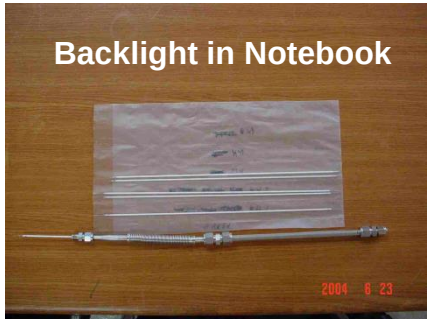
- **Improving Torque Measuring Capability of KRISS**: 0.1 % ('99) ⇒ 0.005 % ('06)
- **Reducing Failure Rate due** to Torque Measurement at **HYUNDAI**: 35.1 % ('99) ⇒ 0.5 % ('06)

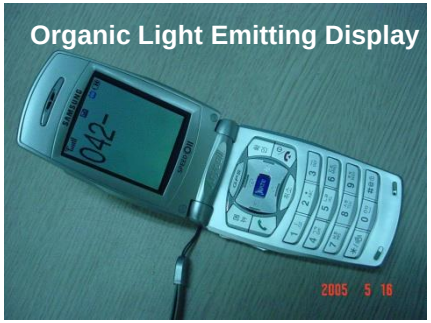
For HYUNDAI Motors

PARTNERSHIP WITH INDUSTRY

MEASUREMENT SOLUTIONS FOR THE ENVIRONMENT

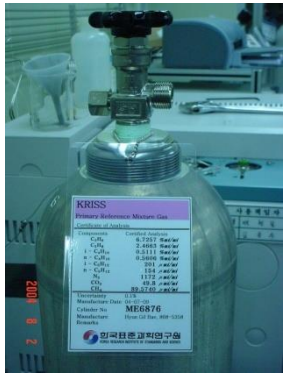
- **Standard Gas for Gas Analysis in Semiconductor & Display industry**





  - Gas Analysis : Quality control of products, development of new product & problem solving in process

- **CRMs for Analyzing Natural Gas Analysis, Green House Gas, Air Pollution**



Prices of natural gases depend on concentrations of components (hydrocarbon)

Standards gas for GHG

Analyzing vehicle gas emission

KRISS and MRA, Joining the CIPM MRA in 1999

Reconnaissance mutuelle
des étalons nationaux de mesure
et des certificats d'étalonnage et de mesurage
émis par les laboratoires nationaux de métrologie
Paris, le 14 octobre 1999
Supplément technique révisé en octobre 2003 (pages 17-20)

Mutual recognition
of national measurement standards
and of calibration and measurement certificates
issued by national metrology institutes
Paris, 14 October 1999
Technical Supplement revised in October 2003 (pages 38-41)

Comité international des poids et mesures

Bureau international des poids et mesures
Organisation intergouvernementale de la Convention du Mètre

RECONNAISSANCE MUTUELLE
DES ÉTALONS NATIONAUX DE MESURE
ET DES CERTIFICATS D'ÉTALONNAGE ET DE MESURAGE
ÉMIS PAR LES LABORATOIRES NATIONAUX DE MÉTROLOGIE

Arrangement rédigé par le Comité international des poids et mesures (CIPM) en vertu de l'autorité qui lui est conférée par les États membres de la Convention du Mètre

MUTUAL RECOGNITION
OF NATIONAL MEASUREMENT STANDARDS
AND OF CALIBRATION AND MEASUREMENT CERTIFICATES
ISSUED BY NATIONAL METROLOGY INSTITUTES

Arrangement drawn up by the International Committee of Weights and Measures under the authority given to it in the Metre Convention

Ce document sera soumis à la signature des directeurs des laboratoires nationaux de métrologie (LNM) des États membres de la Convention du Mètre, à partir du 14 octobre 1999, date de leur réunion à l'occasion de la 21e Conférence générale des poids et mesures.

This document will be open for signature by directors of the national metrology institutes (NMIs) of the Member States of the Metre Convention starting from 14th October 1999, at a meeting of directors that will take place on the occasion of the 21st General Conference of Weights and Measures.

Nom/*Name* Signature	LNM/*NMI**	État/*State*	BIPM Signature
myung Sai chung	KRISS	Rep. of Korea	

*Tous les laboratoires et instituts mentionnés dans cette colonne participent à cet arrangement.
This arrangement covers all the institutes listed here.

KRISS, one of the signatories to the MRA in Oct 1999

Signatories

38 countries+ 2 Int'l org.	92 countries + 4 Int'l org
(IAEA, IRMM)	(IAEA, IRMM, WMO, ESA)
Oct 1999	Oct 2014

Participation in KC, Key Comparisons
CMC Registration, Calibrations and Measurement Capabilities

Field	AUV 음향 진동	EM 전자기	L 길이	MRQ 질량	PR 광도 복사도	QM 물질량	RI 전리 방사선	T 온도	TF 시간 주파수	Total
KC	20	56	23	67	19	104	58	25	1	373
CMC	41	141	41	49	41	519	214	69	24	1139

BIPM KCDB (http://kcdb.bipm.org/ Feb 2014)

Country	USA	Russia	Germany	China	UK	Korea	Japan
CMC	2180	1598	1541	1248	1194	*1139*	1095

Country	Germany	USA	UK	Japan	France	KRISS
KC	644	473	460	438	430	*373*
KC-PL	164	110	100	84	49	62

PL: Pilot Laboratory

QMS: CERTIFIED TO ISO 9001

QMS

Certified to

ISO 9001

- Certification: Feb 2001 - renewed (Oct 2012)
- Certified by KFQ [Korea Foundation for Quality]
- QMS of KRISS ***Complied with***;
  - ISO 9001: 2008 (for QMS)
  - ISO/IEC 17025: 2005 (for Calibration/Test)
  - ISO Guide 34: 2000 (for Reference Materials)
- ***Scope of Certification;***
  - Dissemination of standards: calibration, testing, RM;
  - Research and development activities
  - Administration and technical support activities


CERTIFICATE
QUALITY MANAGEMENT SYSTEM
kfq Korean Foundation for Quality
KOREA RESEARCH INSTITUTE OF STANDARDS AND SCIENCE
1, Doryong-dong, Yuseong-gu, Daejeon, Korea
Korean Foundation for Quality certifies that The Quality Management System of the above organization has been audited and has complied with the requirements of the following standard
Standard
KS Q ISO 9001:2009 / ISO 9001:2008
Scope certification
RESEARCH AND DEVELOPMENT,
DISSEMINATION SERVICES OF STANDARDS

Technical Capability

Recognized by

Peer Reviews

1st round: 2001-2002

2nd round: 2006-2007

3rd round: 2012-2013

KC	CMC	Remarks
373	1139	Oct 2014,KCDB

QMS OF KRISS: HONORED WITH

Global System Grand Prix Award 2009

- **QMS of KRISS recognized in Korea.**
- **Organized by the New Quality Forum;**
- **Sponsored by The Korea Economic Daily.**

Major National Metrology Institutes

Country	NMI	Year of Establishment	Legal Status	Personnel
Germany	PTB /BAM	1887	Governmental Institute	3,000
UK	NPL	1900	Governmental Institute (operated by corporation on contract)	600
USA	NIST	1901	Governmental Institute	2,900
France	LNE	1901	Public Corporation	800
Japan	NMIJ /CERI /NICT	1903	Independent Administrative Foundation	600
Australia	NMIA	1938	Governmental Institute	350
Korea	KRISS	1975	Government-supported Institute	410

독일 PTB, 1887

미국 NIST, 1901

일본 NMIJ, 1903

대한민국 KRISS, 1975

KRISS

1 **KRISS at a Glance**
- *national metrology institute (NMI) of Korea*

2 **Partnership with Industry and Academia**
- *Measurement Clubs, Home Doctors, Technology Transfer*
- *Metrology Research Centers (MRCs)*

3 **Government Role in Advancing S&T and Metrology**
- *for sustainable economic growth: case study for Korea*

4 **GMA in Brief**
- *achievements and plan*

5 **Lessons Learned**
- *and recommendations*

PARTNERSHIP WITH INDUSTRY
PORTFOLIO OF CUSTOMER SERVICES

KRISS

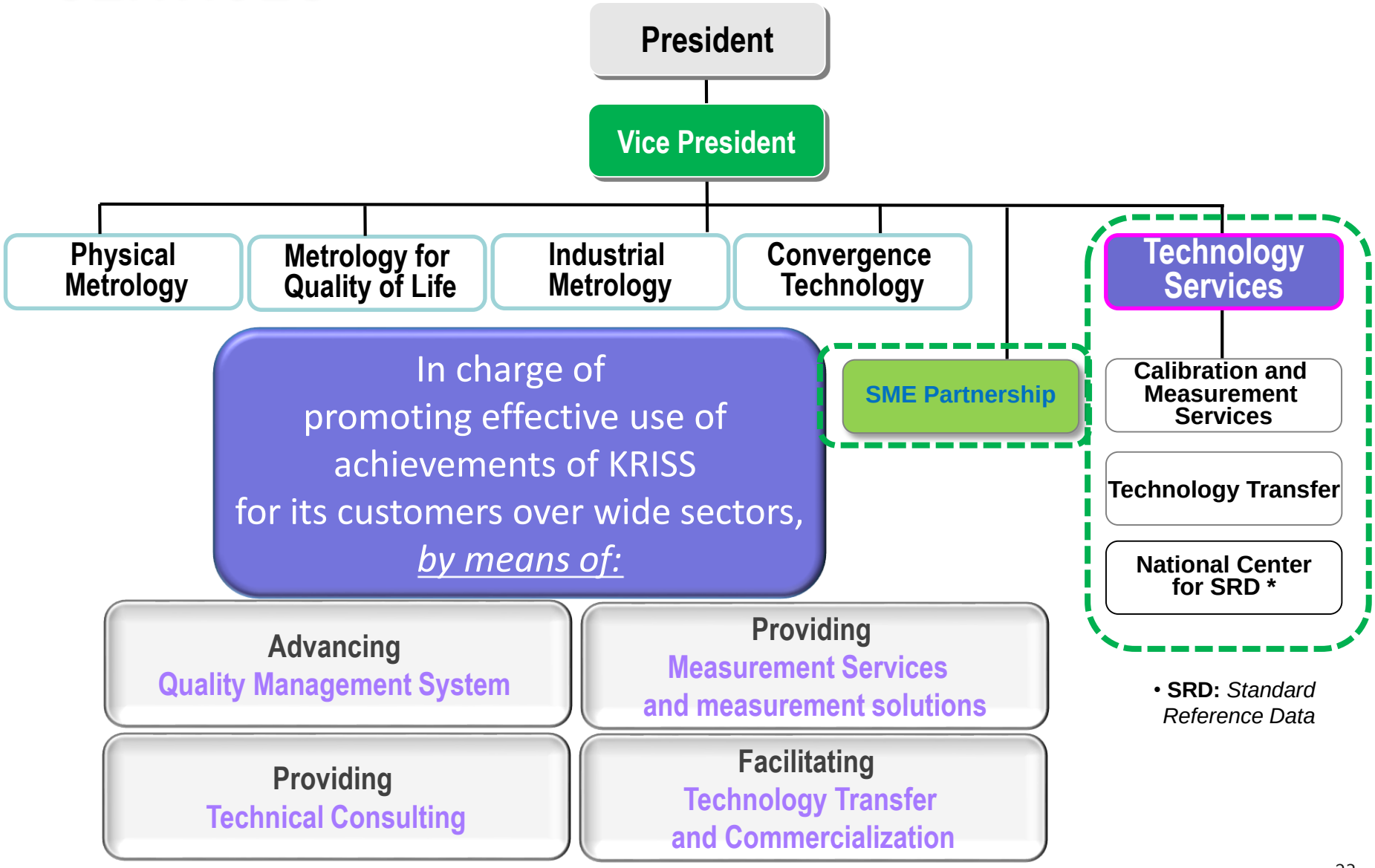
Ever-growing Satisfaction of Customers

Efficient and Advanced System of Services

- *(1) Measurement Clubs*
- *(2) Home Doctors*
- *(3) BEST Program*
- *(4) KRISS User Facilities*

- Calibration, Test, CRM
- Education, Training
- Technical Advice

PARTNERSHIP WITH INDUSTRY
OPERATING UNITS FOR TECHNOLOGY SERVICES



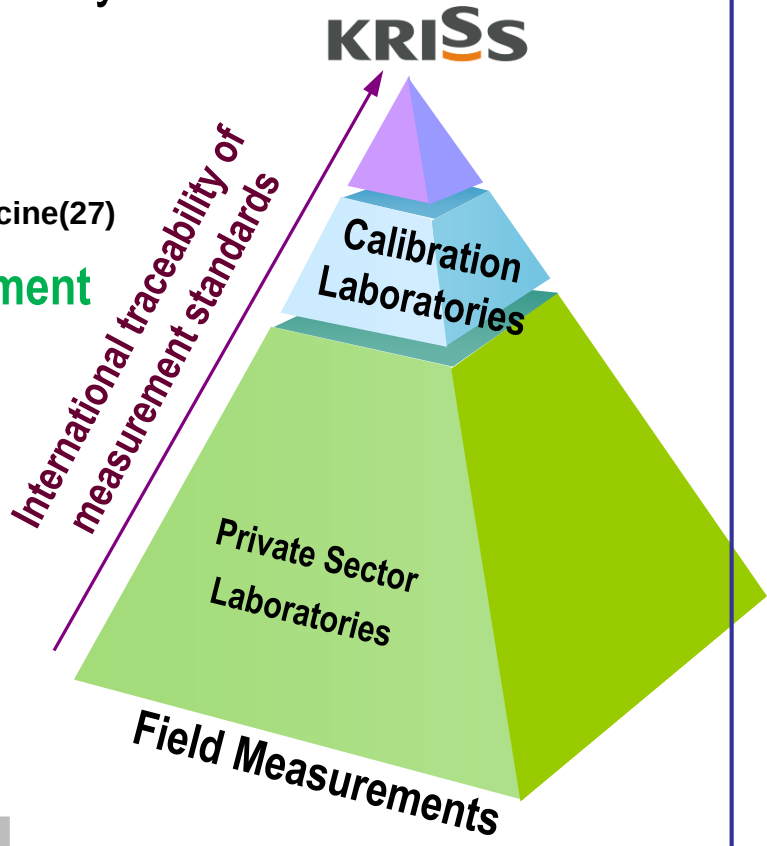
"Traceability for Innovation towards Competitiveness"

- High quality services stimulating innovation of Industry based on internationally recognized traceability
  - **- Calibration, testing and technical consulting**
  - **- Development of CRMs for industry**

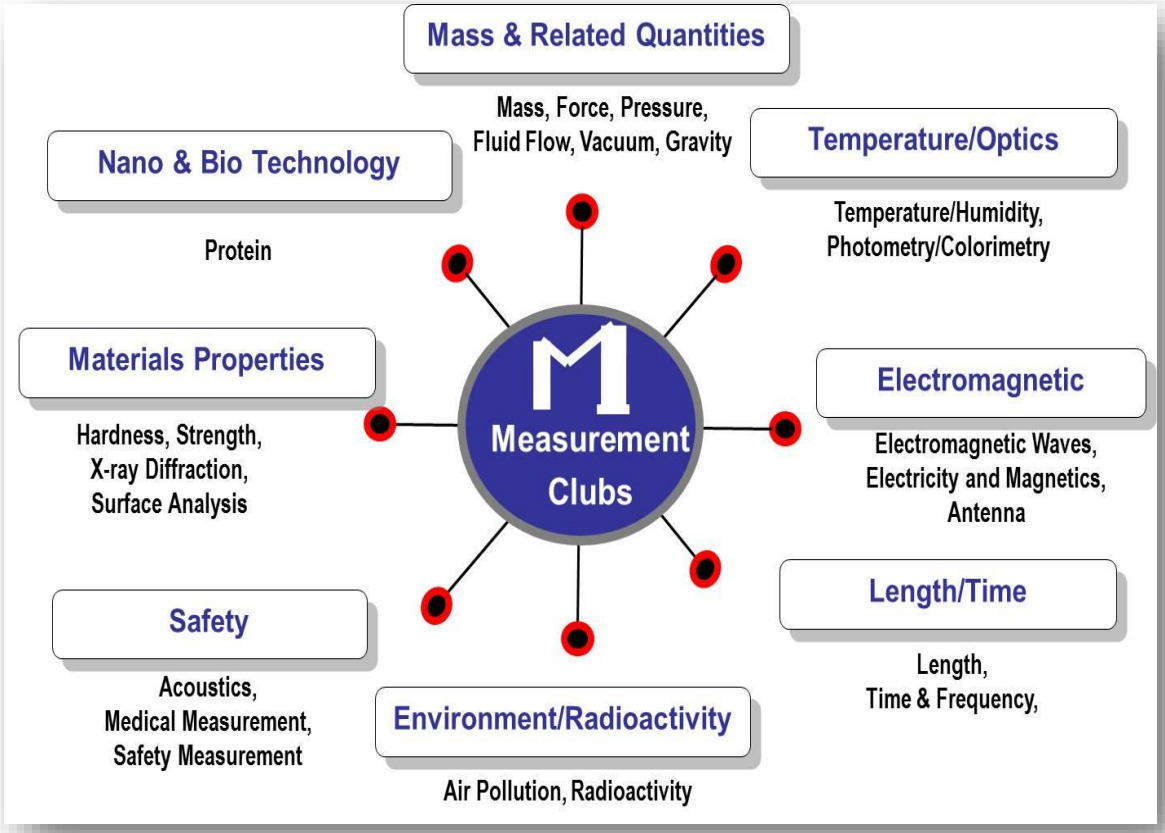
    760 items (Industry(429) / Environment(277) / Food(27) / Medicine(27)
  - **- Training and education on precision measurement**
- Services provided by KRISS ('10-'13)

Year	Calibration	Testing	CRMs	Training
2013	12,054	2,307	3,404	374
2012	16,826	2,957	3,134	515
2011	17,306	3,231	2,735	353
2010	17,742	3,288	2,255	579

Covering over 3000 customer organizations



PARTNERSHIP WITH INDUSTRY
MEASUREMENT CLUBS



22 special interest groups
over 6 000 members

< Measurement Club Workshop >

KRISS Measurement Clubs: 22 Clubs in operation

- 6 000 experts and instrument users from Industry, Academia, Research Institutes;
- Holding on-line and off-line meetings for networking;
- Sharing knowledge and experience of measurement technology

Program: Annual Workshops, Meetings, Tutorial Programs, Exhibitions

PARTNERSHIP WITH INDUSTRY
MEASUREMENT CLUB SUCCESS STORY: VACUUM

▣ Vacuum Club's Impact on the Korean Semiconductor Industries

Vacuum Club Workshop

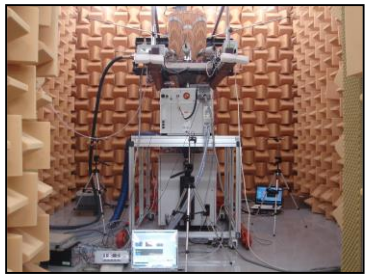
Measurement club

✓ **Over 50 companies joining**

Vacuum club

✓ **Identifying need of measurement technology for vacuum dry pump**

Vacuum measurement:
Key role in
Quality Control of Semiconductor production



➢ **KRISS developed Measurement System for Vacuum Dry Pump**

➢ **In-situ monitoring of pump degradation possible**
➢ **Without stopping production line**

☞ **Diagnosis of dry vacuum pumps in new, existing, or developmental stages**

☞ **Beneficiaries includes SAMSUNG Electronics**
- Hub evaluation system established

PARTNERSHIP WITH INDUSTRY
HOME DOCTOR PROGRAM

KRISS

One expert for one Company

Visiting client companies (4-6 times/year)
- To find technical problems and to provide consulting on site

Inviting client companies to KRISS
- To conduct experiments with KRISS facilities

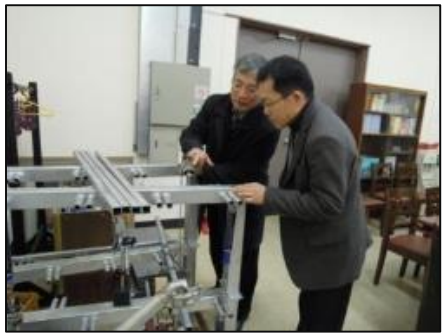
Providing education/training for client companies

On-line communication offering recent technical news

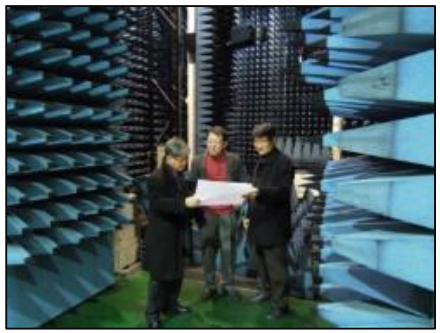
40 KRISS experts
Serving
40 companies
(2013)

Major fields	Consulting technologies
• Mechanical measurements • Electricity & magnetism • Semiconductor manufacturing facility • Material evaluation • Optics	• Ultrasonic flowmeter, thermometer, Laser technology for length measurement • Current transformer, oscilloscope, switches for rail-road system, • Vacuum pump, chemical vapor pressure, precursor materials • Non-destructive test, bridge safety test, concrete hardness test • Optical photometer

Semiconductor materials Co.



Vibration absorption Co.

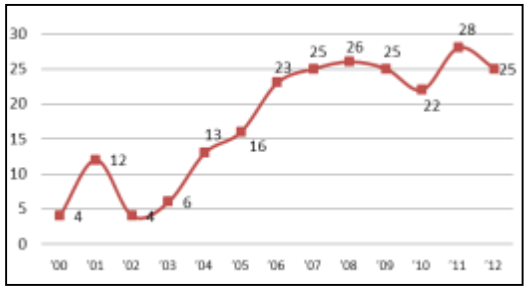


Communication equipment Co.

Provide Solutions to Technical Difficulties for SMEs
☞ Sales Rise, Job Openings, Localization of Products, etc.

Technology Transfer to Industries

- Over 25 annual cases of technology transfer to industries
  - KRISS earned 1.2 million USD in royalties every year (2008 – 2012)



Success story in Technology Transfer

- Measurement Technology on MCG (Magnetocardiography)
  - Technology transfer agreement with German company (BMP Inc.)
  - Initial Royalty: USD 1.4 million

Numbers of Tech. Transfer

Year	'00 -'07	'08	'09	'10	'11	'12	Total
Total	164	28	25	26	28	25	296

Income by Tech. Transfer (Million USD)

Year	'00 -'07	'08	'09	'10	'11	'12	Total
Total	1.5	2.4	0.5	1.1	1.2	1.4	8.1

KRISS

1 **KRISS at a Glance**
- *national metrology institute (NMI) of Korea*

2 **Partnership with Industry and Academia**
- *Measurement Clubs, Home Doctors, Technology Transfer*
- *Metrology Research Centers (MRCs)*

3 **Government Role in Advancing S&T and Metrology**
- *Effective and nvestment for Metrology*

4 **GMA in Brief**
- *achievements and plan*

5 **Lessons Learned**
- *and recommendations*

Government Role In Advancing S&T and Metrology

KRISS Korea Research Institute of Standards and Science

ECONOMIC GROWTH OF KOREA (1)

KRISS

Grown up to be
World's 8th Largest Exporter today

Construction
Burj Khalifa (Dubai)

Wireless Telecom Equipment

Computers, Semiconductors

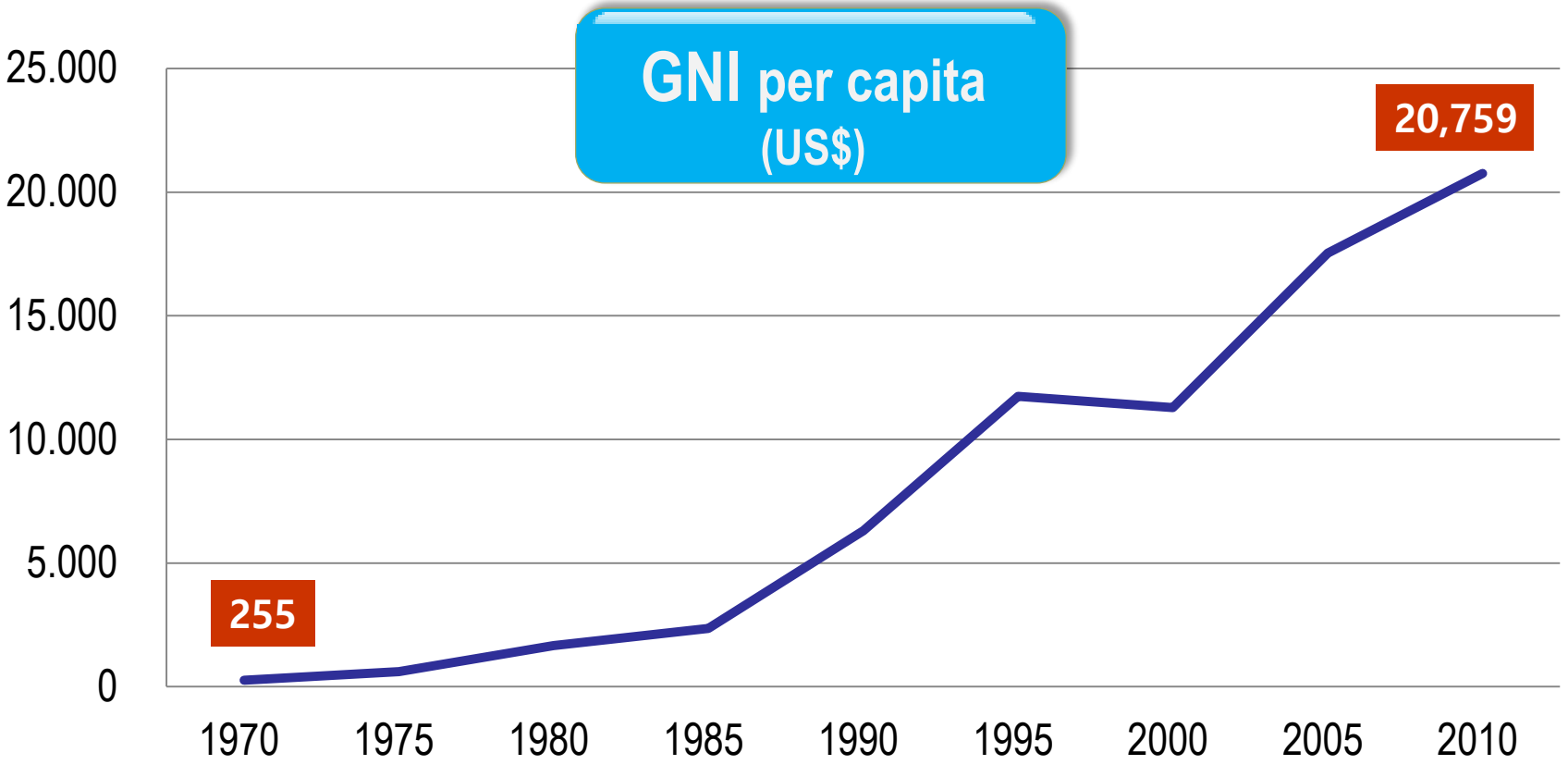
Petrochemicals

Automobile

Steel

Shipping building

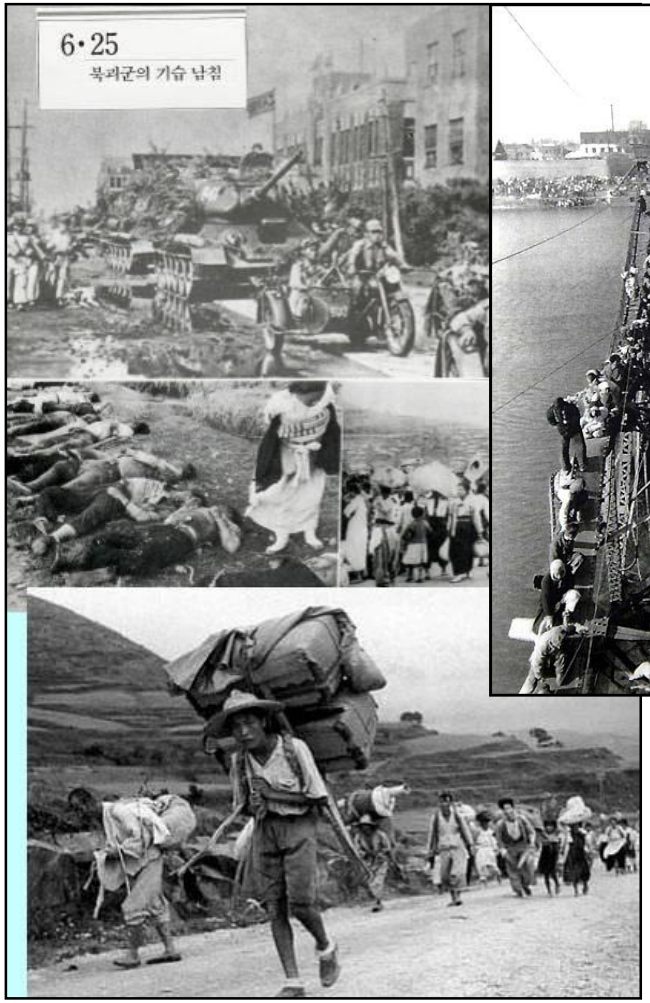
ECONOMIC GROWTH OF KOREA (2)

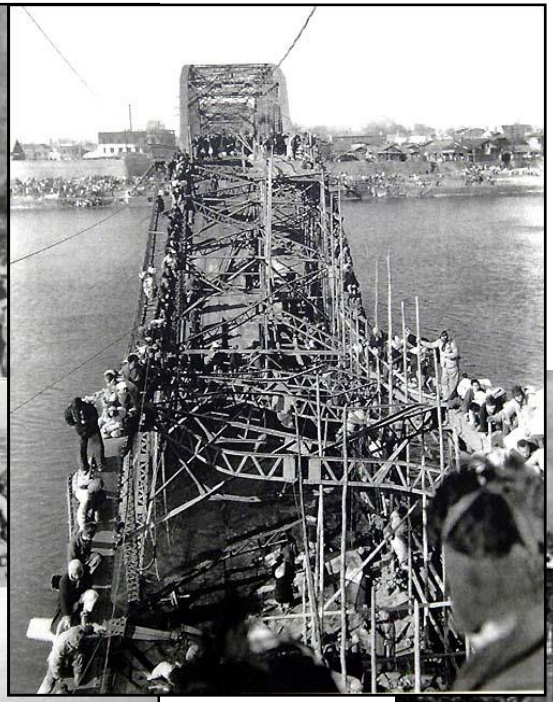


Year	'70	'75	'80	'85	'90	'95	'00	'05	'10
GNI per capita (U$)	255	607	1,660	2,355	6,303	11,735	11,292	17,531	20,759

- *US$**79** (1960): second to the lowest in the world* ***(* increased more than 250 times for 50 years:1960-2010)***
- http://kosis.kr/

The Korean War destroyed almost everything in the peninsula





Independence: 1945
Government Election: 1948
Korean War: 1950. 6. – 1953. 7.

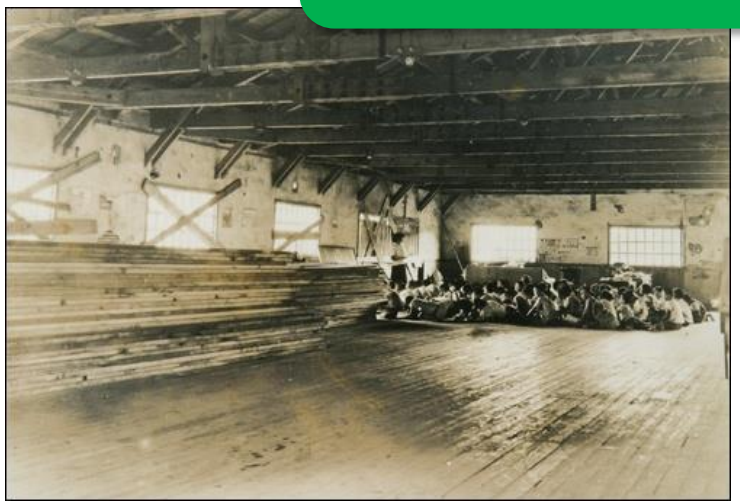
KwangWhaMoon Ave., Seoul

Grown up as it is from nearly no resources but . . .

Human resources

Lessons Learned

Human Resources → Key the Success



Schools during the Korean War (1950's)

WHAT HAS MADE IT POSSIBLE?

- Government's Initiatives
- Helping hands from abroad
- Strong Leadership of President
- Enthusiasm for Education
- Diligence of Korean People

Key driving force for today's economic prosperity of Korea

Series of 5-year
Economic Development Plans
(1962~1987)

Series of 5-year
S&T Development Plans
(1962~1987)

S&T: SUPPORTING ECONOMIC GROWTH OF KOREA

Characteristics of S&T Development Plans in Korea in 60's-70's

Setting up S&T Development Plans

Synchronized with and in support of
Economic Development Plans

Establishment of GRIs

- To be professional R&D institutes in specific areas of S&T
- **29 GRIs** in operation

Research-friendly environment for GRIs

- Independent legal status of GRI's
- Continued stable financial support

Recruiting the Brain

- Attracting Korean scientists who studied abroad to come back
- Higher competitive salary scale: 3 times more than academia

- GRI: Government-funded Research Institute

S&T: ESTABLISHMENT OF THE GRIS

KRISS

1960's (2)

Korea Institute of Science and Technology Information (**KISTI**, 1962)

Korea Institute of Science and Technology (**KIST**, 1966)

1970's (9)

Korea Atomic Energy Research Institute (**KAERI**, 1973)

Korea Ocean Research Development Institute (**KORDI**, 1973)

Korea Research Institute of Standards and Science (KRISS, 1975)

Electronics and Communications Research Institute (**ETRI**, 1976)

Korea Research Institute of Chemical Technology (**KRICT**, 1976)

Korea Institute of Machinery and Materials (**KIMM**, 1976)

Korea Institute of Energy Research (**KIER**, 1977)

1980's (7)

Korea Institute of Construction Technology (**KICT**, 1983)

Korea Research Institute of Bioscience & Biotechnology (**KRIBB**, 1985)

Korea Astronomy and Space Science Institute (**KASI**, 1986)

Korea Basic Science Institute (**KBSI**, 1988)

Korea Aerospace Research Institute (**KARI**, 1989)

⋮

1990's (2)

Korea Railroad Research Institute (**KRRI**, 1996)

⋮

2000's (6)

29 Government-funded Research Institutes are currently in operation

Legal basis for KRISS

Dec 1973

- **Law on Establishment and Promotion of Government-supported Research Institutes**

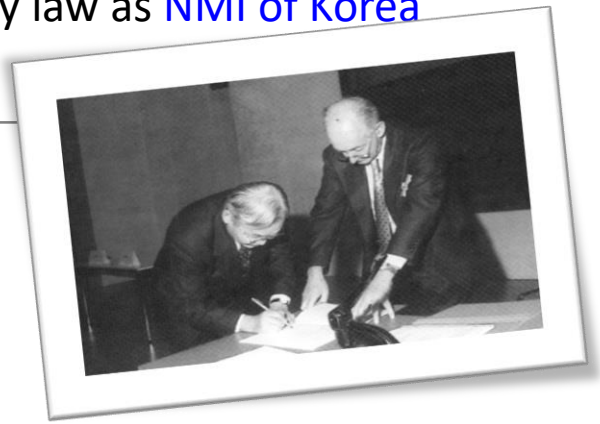
Sept 1980

- **Constitution** (Article 127)

  "The State shall Establish National Standards System!"

Feb 1999

- **Framework Act on National Standards** (Article 13)
  - Officially designated KRISS by law as NMI of Korea
  - To join CIPM MRA



Creating KSRI as NMI of Korea in 1975

- To support export-driven economy;
- By providing reliability of exported products of Korea

Groundbreaking Ceremony

Early Stage of Constructing KSRI campus

Government Support for KRISS

Loan Projects for KRISS

(Unit: US$)

Resources	Activities	Amount
US AID (1975-1980)	. Construction, Equipment, Orientation of researchers	5,000,000
ADB (1979-1981)	. Equipment	8,000,000
OECF (1986-1987)	. Equipment, Training	6,000,000
IBRD (1990-1991)	. Equipment	6,000,000
IBRD (1994-1995)	. Equipment	10,000,000
* PTB (1979-1996)	. Equipment, Training, Advice	1,952,000
* JICA (1991-1996)	. Equipment, Training, Advice	8,401,000

* Donation for Technical Cooperation

Invested in; Building laboratories;
Purchasing equipment;
Recruiting/Training researchers

→ Laying foundation of KRISS as NMI of Korea

MAP OF KRISS CAMPUS

On 500 147 ㎡ site of its campus, KRISS has more than 30 buildings, which are accommodating its R&D activities and technical services over wide areas of metrology, ranging from fundamental sciences to the cutting-edge areas of applied measurement technologies.

FOR HUMAN RESOURCES OF KRISS

Competent Research Scientists

- Recruiting from advanced countries
- more than 95 % of Researchers with Ph.D. degrees

Continuing Training at Advanced NMIs

- Orientation to be Metrologists
  ➔ for 6-12 months at US NBS (63 people in '70's-'80's)
- Mid/long-term training at PTB (42 people in '70's-'90's)
- Technical study at advanced NMIs (young generation)

Wide Scope of Capability

- Physics + PLUS
  + Chemistry, Materials, Bio, Nano, etc.
- Solutions for Global Agenda
  ➔ Meeting the evolving needs of metrology

National Metrology Institute

Government Research Institute

FOR MEASURING EQUIPMENT OF KRISS

Enduring Investment of Big Volume

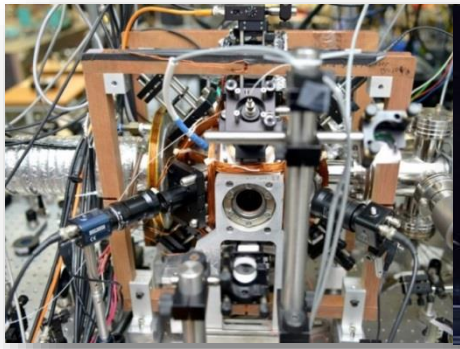
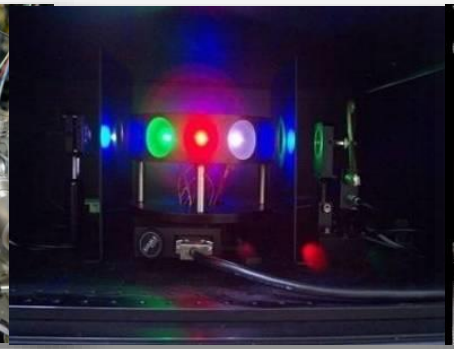
Specifications Appropriate for NMI

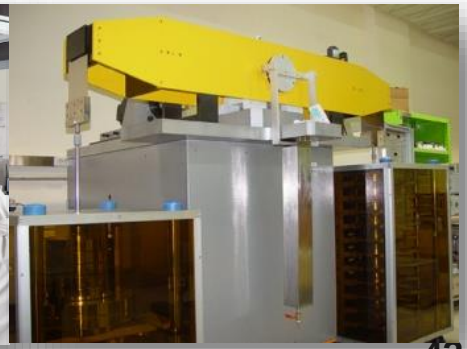
Strategic Investment of Loan

- More than 90 % of Foreign Loan & ODA
- used for purchasing equipment

Advice of Advanced NMIs

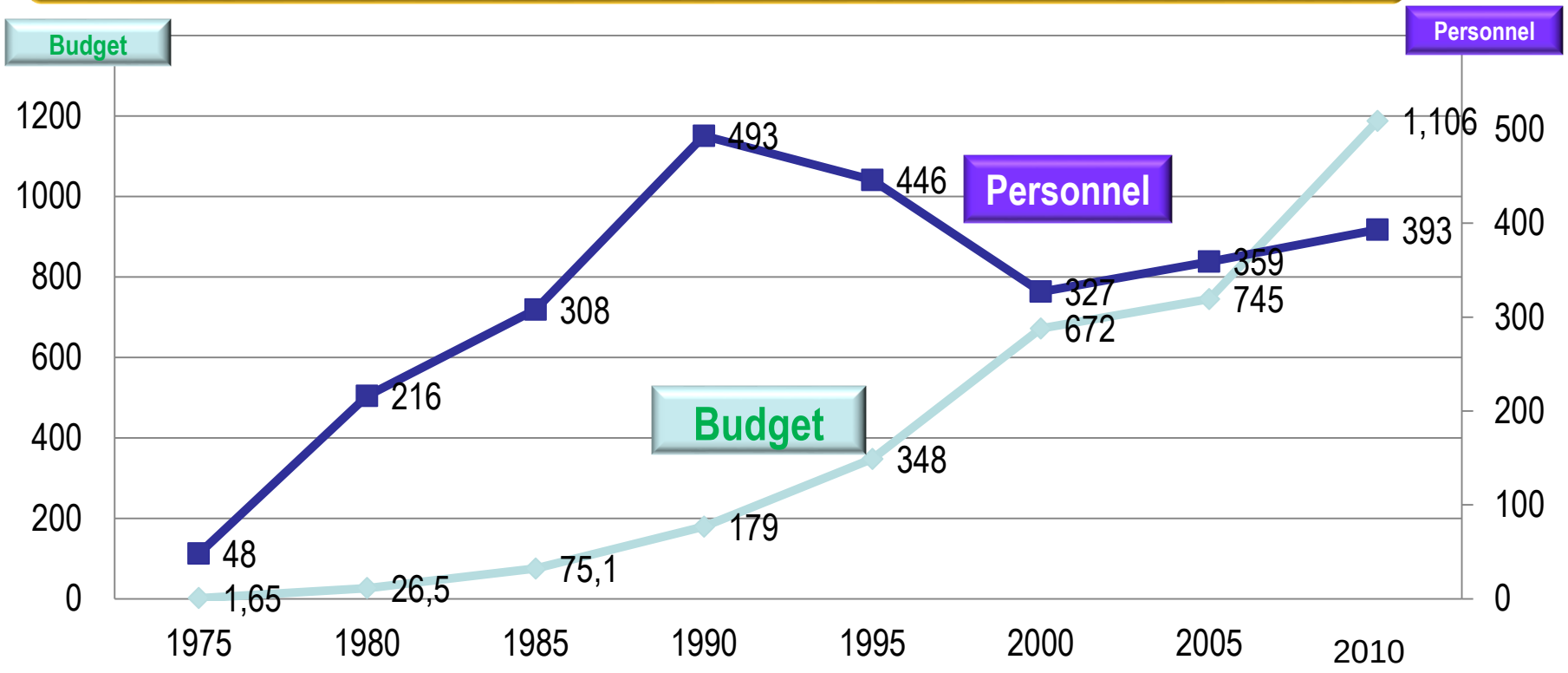
- Selection of equipment and its specifications
- appropriate for the mission of NMI
- in view of expanded needs



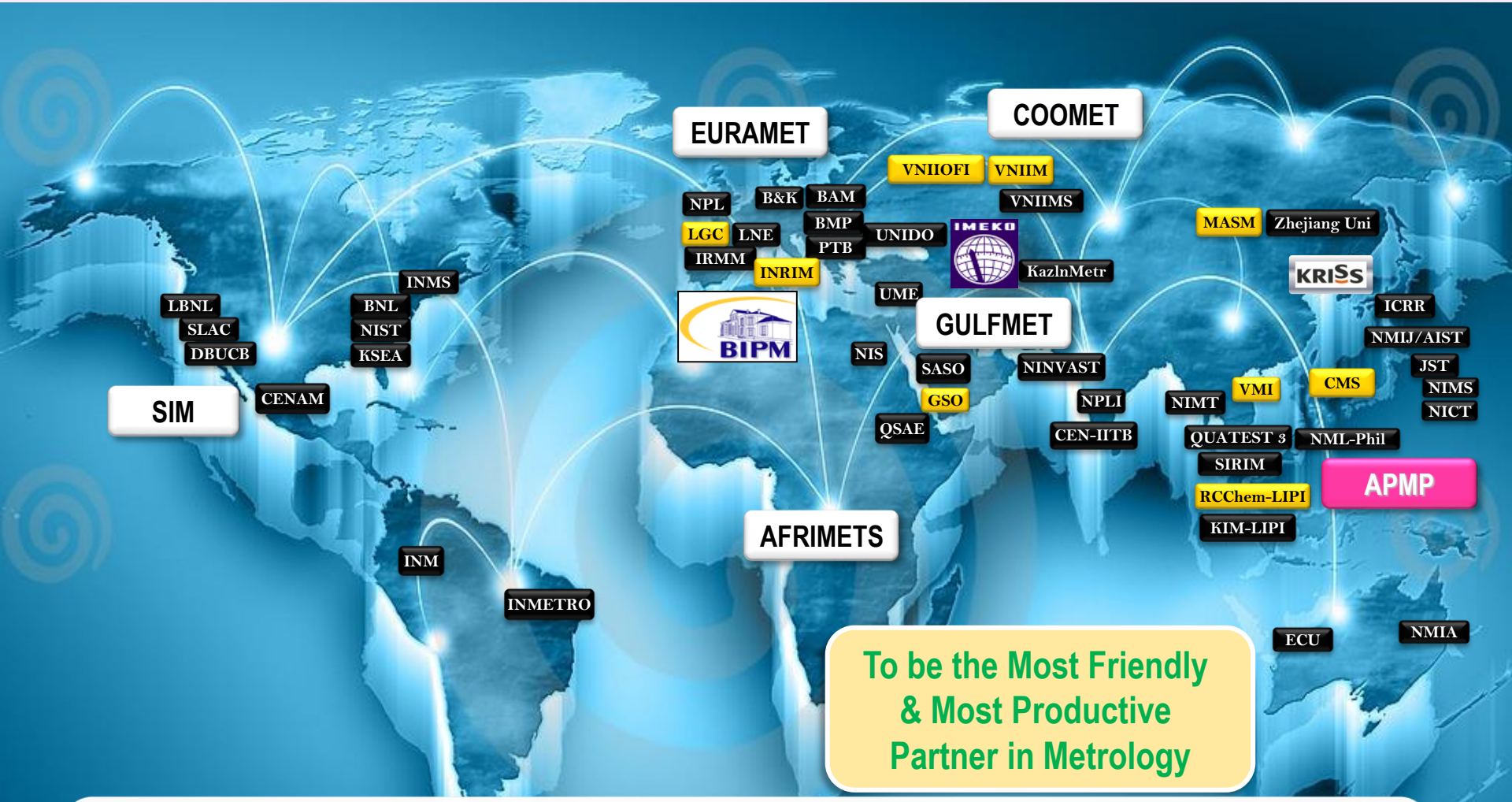
Government Support for KRISS

Ever increasing Resources for KRISS (Financial & Human resources



ACCOUNT	'75	'80	'85	'90	'95	'00	'05	'10
GNI per capita (U$)	607	1,660	2,355	6,303	11,735	11,292	17,531	20,759
Budget (100 Mil Won)	1.65	26.5	75.1	179.4	347.5	671.7	744.9	1,105.9
Personnel (Permanent)	48	216	308	493	446	327	359	393

Global Partnership of KRISS



Global network of collaborations with more than 50 partners over the world

(53 institutions and International Organizations]

PARTNERSHIP WITH GLOBAL METROLOGY COMMUNITIES

CIPM

- Membership to 9 Consultative Committees of CIPM
- CIPM membership (since 1996~)

(CIPM: International Committee of Weights and Measures)

APMP

- Chairperson, Secretariat of APMP (2007-2009)
- EC member (2009-) * *Asia-Pacific Metrology Programme*
- Chair of Technical Committees

(TCPR, TCM, TCEM, TCFF, TCTF, TCL,TCRI, TCT, TCQM, TCMM, TCQS)

IMEKO

- President of IMEKO *(International Measurement Confederation)*
- Chair of Technical Committees

(TC3, TC5, TC8, TC16, TC23, TC24)

Working in close partnership with global metrology communities and partner NMIs → allows KRISS to play a leading role in solving the global issues of metrology such as the CIPM MRA.

About 30 KRISS staffs being leaders in International Organizations

PROGRAMS FOR DEVELOPING COUNTRIES

KRISS

Group Training Program

Workshop on National Standards System (since 1983)

- Two weeks at KRISS training on fundamental subjects of measurement standards
- Annually organized since 1983, funded by KOICA
- About 15 participants from developing countries

Individual Training Program

Customized program to meet the needs of trainees (since early 90's)

- Short- and long-term courses depending on need analysis
- Egypt, Indonesia, Sri Lanka, Vietnam, Malaysia, Mongolia, Pakistan, Philippines, etc.
- Education: Master's and doctoral courses for advanced degrees (UST)

Measurement Service Program

Calibration, Testing, CRM Services (since mid-90's)

- Providing quality services at *special rates*
- Malaysia, Mongolia, Pakistan, Philippines, Sri Lanka, Thailand, Vietnam, etc.

Technical Consultation Program

Technical Advice on site and Peer Reviews (since early 90's)

- Providing technical consultations and peer reviews on measurement standards
- Indonesia, Malaysia, Mongolia, Vietnam, Iraq, Colombia, Ethiopia, etc.

CONTENTS

Human Resources

➔ key to success

In Science & Technology

PROFESSIONAL

HR

Key Roles

PORTFOLIO OF GMA PROGRAMS

GMA

Courses at KRISS

Group, Individual

- Group courses
  - · Duration: Two-week intensive programs
  - · Covering fundamental subjects of metrology
  - · Lectures combined with hands-on practice
- Individual courses
  - · Duration: Two weeks to one year
  - · Tailored to meet the specific needs of customers

Outreach Services

- on site of customers

Comprehensive approach

- A group of metrologists of KRISS visiting customers on site
  - · Offering on-site technical advice, training and lectures
  - Capability evaluation, offering recommendations of action plan
  - · Advice on strategic planning of national standards system, etc

Graduate Courses

Master's, Doctoral

- UST-KRISS Graduate School of Metrology (www.ust.ac.kr)
  - · For master's and doctoral degrees
  - · Funded by KRISS

KRISS

BACKGROUND, OBJECTIVES

Demand of HRD in Metrology ever increasing from the developing world

Limited Resources available at KRISS (Human and financial resources)

Needs for raising higher efficiency and effectiveness by incorporating HRD programs of KRISS

Needs for sharing and raising understanding of the fundamental knowledge and up-to-date information about metrology **within KRISS community**

More systematic approach to HRD programs required

WHY GMA? ...COMPETITIVENESS

GMA

High qualified metrologists as lecturers	More than 220 research scientists having doctoral degrees
Rich experience of HRD in metrology	Annual training workshop on NSS for developing countries **since 1983** funded by the **KOICA**
Wide coverage of metrology areas	Covering measurement in physics, chemistry, materials, nanotechnology…
Global network of cooperation	Close partnership with NMIs and international organizations such as **UNIDO**

- **NSS:** National Standards System

* **KOICA:** Korea International Cooperation Agency

* **UNIDO** United Nations Industrial Development Organization

KRISS

CONTENTS

HIGHLIGHTS 2013-2014: STATISTICS

Group courses	Individual courses	Graduate studies	Outreaching services	Technical subjects covered
112 Participants	16 Participants	16 In progress	1 Customer	Fundamental areas of metrology; LDM, MRQ, EM, EM, TH, MiC, AUV, FF, GA
30 Countries	9 Countries	9 Joined (2013-2014)	2 KRISS experts	

144 people from 35 countries

112 people in 6 group courses in metrology

32 people for tailored individual/ graduate studies

GROUP COURSES: BENEFICIARIES

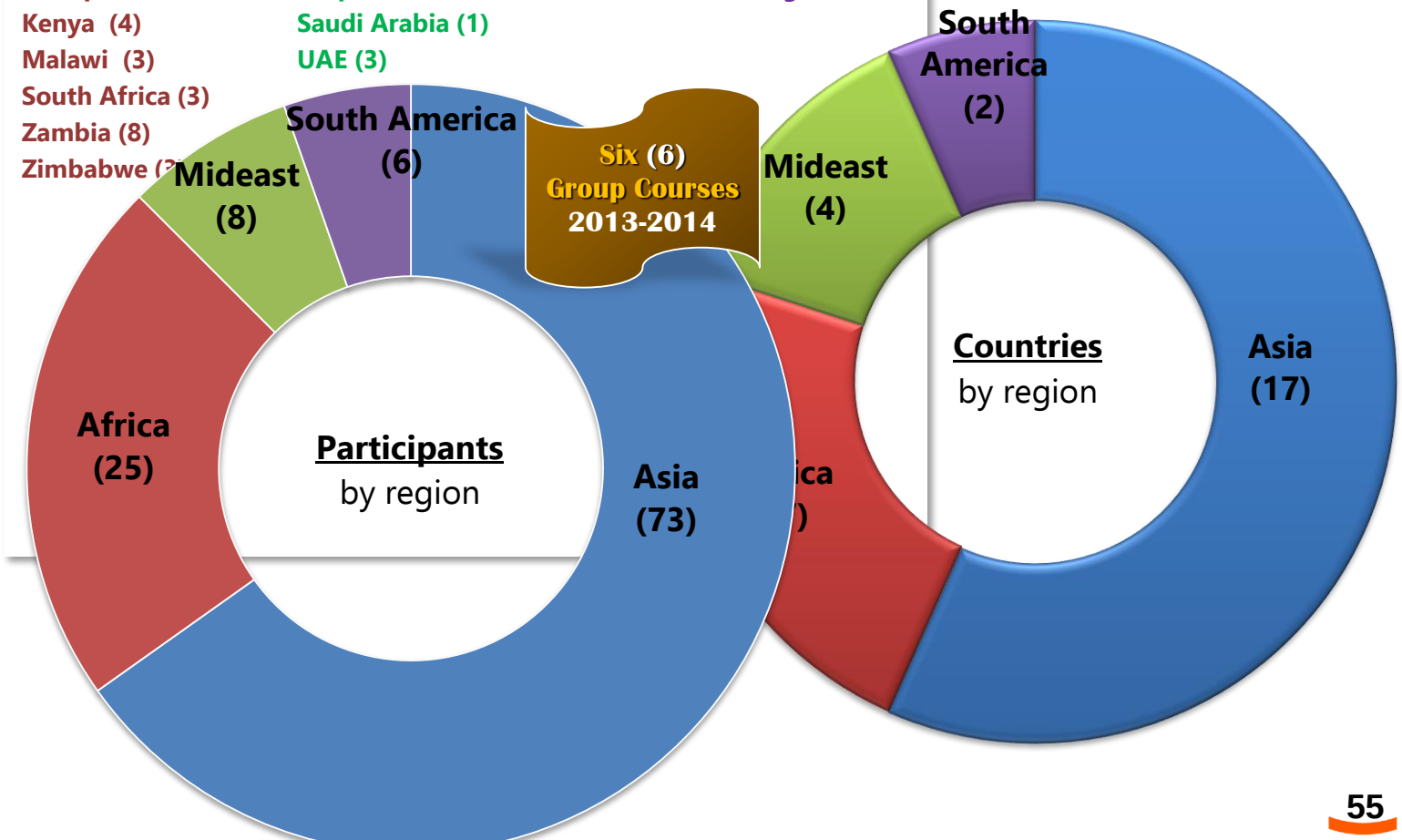
Asia	Africa	Mideast	South America	Total
17	7	4	2	30 countries
73	25	8	6	112 participants

Bangladesh (6)
Bhutan (2)
China (4)
Chinese Taipei (1)
Hong Kong (4)
Indonesia (10)
Japan (2)
Korea (6)
Lao (2)
Malaysia (1)
Mongolia (6)
Myanmar (2)
Nepal (2)
Pakistan (4)
Philippines (10)
Sri Lanka (4)
Vietnam (7)

Botswana (1)
Ethiopia (3)
Kenya (4)
Malawi (3)
South Africa (3)
Zambia (8)
Zimbabwe (3)

Egypt (3)
Iraq (1)
Saudi Arabia (1)
UAE (3)

Colombia (4)
Trinidad and Tobago (2)



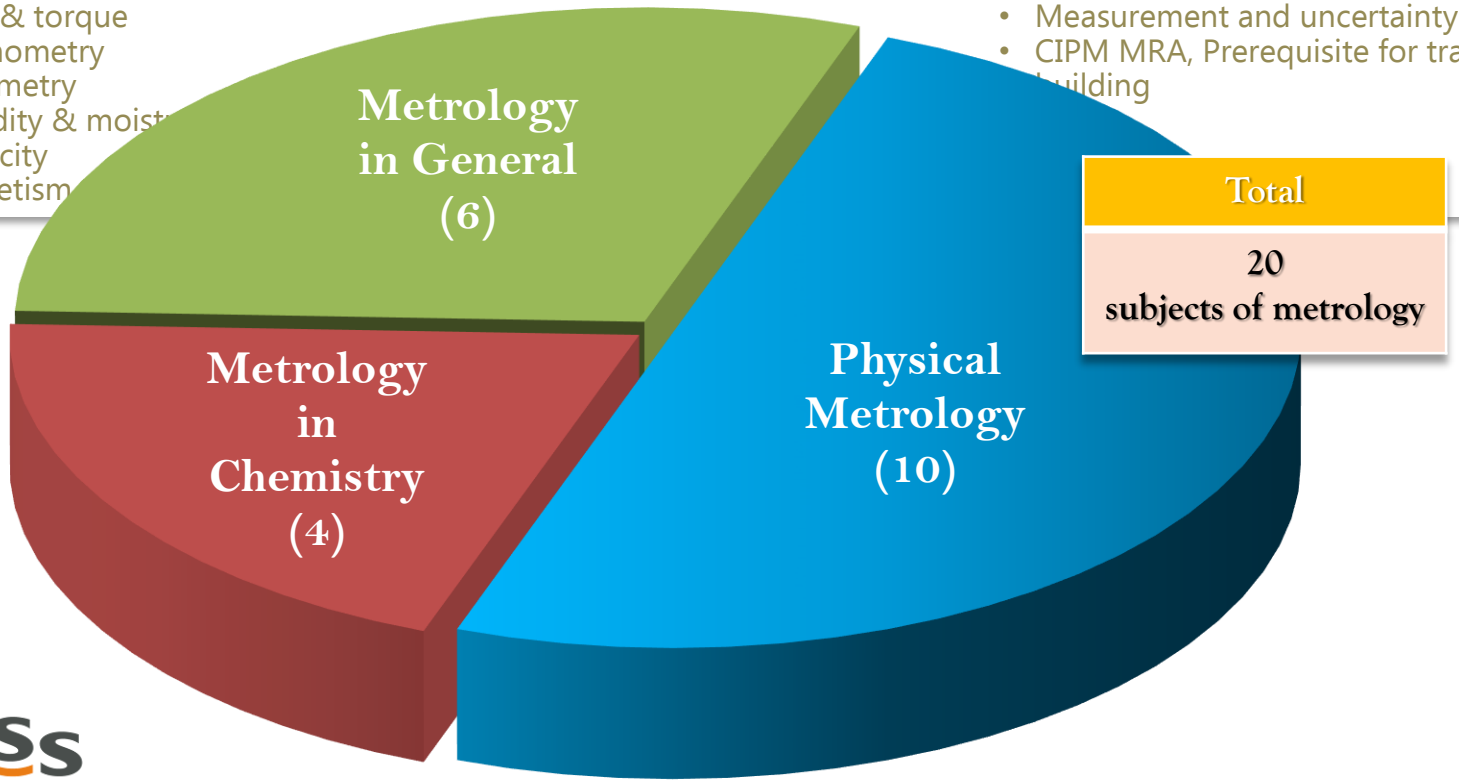
GROUP COURSES: SUBJECTS COVERED

Fundamental Physical Metrology	Metrology in Chemistry	Metrology in General	Total
10	4	6	20

- Length and dimensional measurement
- Mass
- Volume & density
- Pressure
- Force & torque
- Thermometry
- Radiometry
- Humidity & moist
- Electricity
- Magnetism

- Organic analysis
- Inorganic analysis
- Gas analysis
- Bioanalysis

- Korean strategies for STI development and role of standards
- National standards system
- Economic impact of metrology and NMI
- QMS: ISO/IEC 17025
- Measurement and uncertainty
- CIPM MRA, Prerequisite for trade capacity
  uilding



GROUP COURSES 2013: PROGRAM OVERVIEW

Three (3) group courses | 50 participants from 25 countries

Course	Subjects/Modules	Dates	Participants
UNIDO-KRISS Workshop 4	Length, Mass, Thermometry/Humidity	April 14 - 26, 2013	14 (7 countries)
GMA-GT-2013-01 Electricity and Magnetism	Voltage and current, DC resistance and impedance, High voltage/current and power, Magnetic field	June 23 - July 4, 2013	19 (16 countries)
GMA-GT-2013-02 Chemistry	Gas analysis, Bio analysis Organic analysis, Inorganic analysis	September 2 - 13, 2013	17 (12 countries)

- Each course includes MiG (metrology in general) session.
- Laboratory sessions consist of technical lectures and corresponding hands-on practices.

GROUP COURSES 2013: PROGRAM OVERVIEW

UNIDO-KRISS Workshop 4	Subjects	Time slots allocated
MiG Metrology in General	NSS in Korea, QMS requirements, Uncertainty in measurement	3.5 days (including evaluation)
	Lab report presentation	1.0 day (presentations followed by Q&A)
Physical Metrology	Length, Mass/Pressure, Temperature/Humidity	4.0 days each – parallel sessions (technical lectures plus hands-on practice, wrap-up discussion)
Metrology in Chemistry	Overview	0.5 day (including lab visit)
Industrial/ cultural visits	Visiting SAMSUNG Electronics, cultural experiences in Seoul	Two days (Friday, Saturday)

Farewell dinner dressed in gorgeous traditional colors

Laboratory sessions

Lab report presentation

Enjoy hot and spicy Korean dishes!

GROUP COURSES 2013: PROGRAM OVERVIEW

Metrology in Electricity & Magnetism [GMA-GT-2013-01-EM]

Participants: 19 people from 16 countries

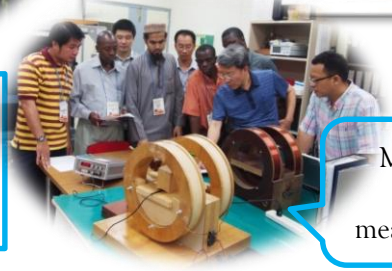
Bangladesh	NML-BSTI	2	Malawi	MBS	1
China	NIM	1	Mongolia	MASM	2
Hong Kong	SCL	1	Philippines	NML-ITDI	1
Indonesia	KIM-LIPI	1	Zambia	ZABS	1
Iraq	COSQC	1	Zimbabwe	NMI-SIRDC	1
Japan	NMIJ	1	Vietnam	QUATEST 3	1
Kenya	KEB	1	Sub-TOTAL (from abroad)	13 countries	15 People
Ethiopia	NMIE	1	Korea	KRISS	2
South Africa	NMISA	1	Sub-Total (within KRISS)	3	4
			TOTAL	**16 countries**	**19 people**

Asia	12/9 countries
Africa	6/6 countries
Mid-East	1/1 country

GROUP COURSES 2013: PROGRAM OVERVIEW

GMA_GT_ 2013-01-EM	Subjects/Modules	Time slots allocated
MiG Metrology in General	NSS in Korea, QMS requirements, Uncertainty in measurement	1.5 days (including evaluation)
	Presentation of Action Plans	0.5 day (presentations followed by Q&A)
Metrology in EM Electricity & Magnetism	**EM-01**: Voltage and current **EM-02**: Resistance and impedance **EM-03**: High voltage, High current, Power **EM-04**: Magnetic field	8.0 days (four modules with two days for each; technical lectures plus hands-on practice)

Refreshment at Dong-Hak-sa Buddhist temple!... Could you find an entrance to heaven?



Magnetic field measurement

Intensive Lab Sessions! The summer was hot and humid~

Lotto at the farewell dinner! Hi, Mr. Safaa! Don't be so serious^*^

* Orientation & tour in and vicinity of Daejeon offered on Saturday before opening

GROUP COURSES 2013: PROGRAM OVERVIEW

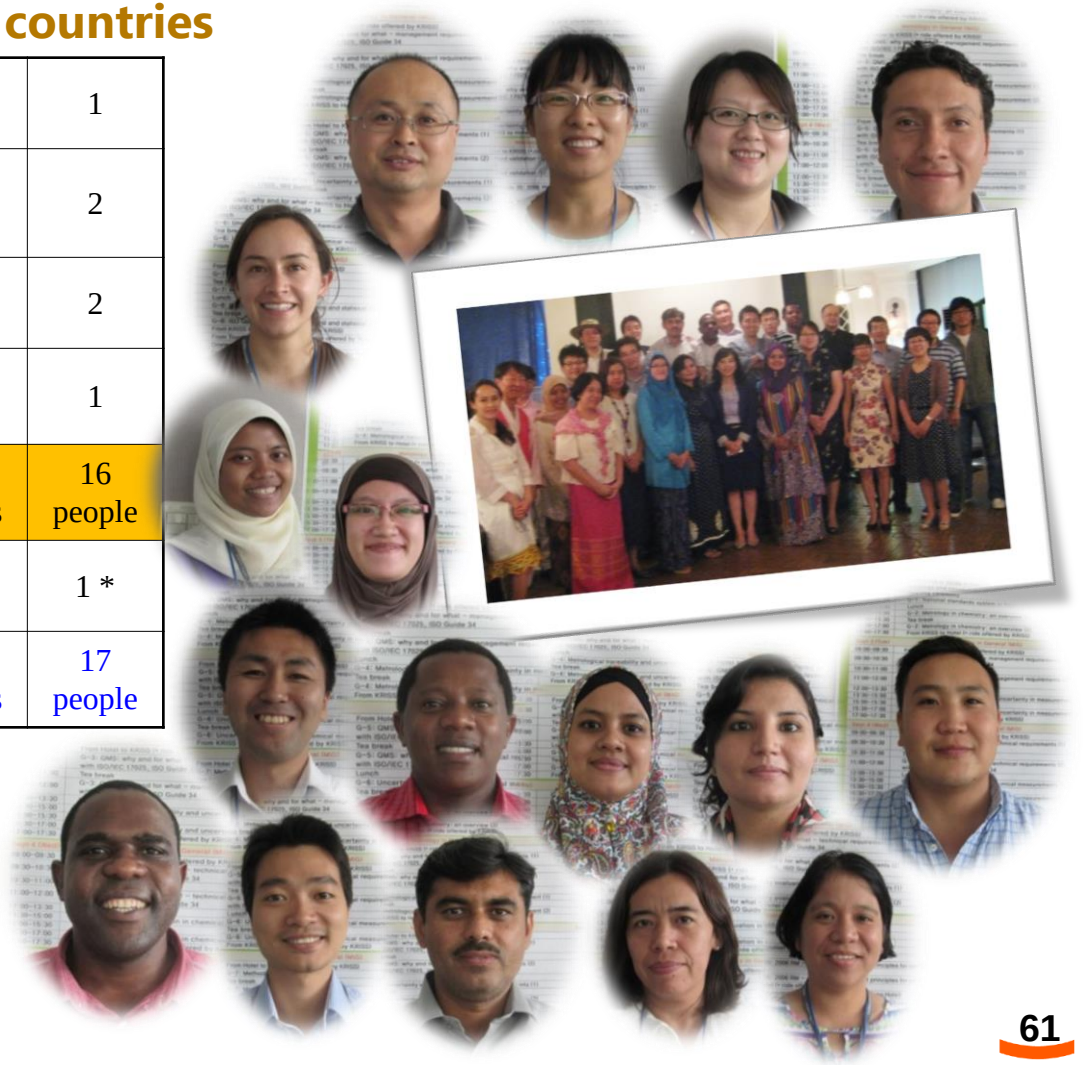
Metrology in Chemistry [GMA-GT-2013-02-QM]

Participants: 17 people from 12 countries

China	NIM	2	Mongolia	MASM	1
Chinese Taipei	CMS	1	Pakistan	NPSL	2
Colombia	INM	2	Philippines	ITDI	2
Indonesia	RCChem -LIPI	2	Vietnam	VMI	1
Japan	NMIJ	1	Sub-TOTAL	11 countries	16 people
Kenya	KEB	1	South Africa	NMISA	1 *
Malaysia	KIMIA	1	TOTAL	12 countries	17 people

Asia	13/9 countries
Africa	12/2 countries
South America	2/1 country

- **NMISA: UST Student**



GROUP COURSES 2013: PROGRAM OVERVIEW

GMA_GT_ 2013-02-QM	Subjects/Modules	Time slots allocated
MiG Metrology in General	NSS in Korea, QMS requirements, Uncertainty in measurement	3.5 days (including evaluation)
	Presentation of Lab reports	1.0 day (presentations followed by Q&A)
MiC Metrology in Chemistry	**QM-01**: Gas analysis **QM-02**: Bio analysis **QM-03**: Inorganic analysis **QM-04**: Organic analysis	5.0 days (four modules with two days for each; technical lectures plus hands-on practice)

17025+34=?
QMS for metrologists in chemistry!

!Hola!
Do you remember what the seven pillars behind you symbolize? ☺

Organic?
Inorganic?

The woman power grows stronger in the arena of MiC!

Gentlemen!
We were minority by 8:9.

* Four modules covering the key subjects of metrology in chemistry were presented.

GMA and global KRISSians

GROUP COURSES 2014: PROGRAM OVERVIEW

Three (3) group courses | 62 participants from 21 countries

Course	Subjects/Modules	Dates	Participants
GMA-GT-2014-01 **MRQ**	**Mass and Related Quantities** mass, density, force, torque, pressure	March 10-21, 2014 (2 weeks)	***22*** ***(12 countries)***
GMA-GT-2014-02 **LDM**	**Length and Dimensional Measurement** Length, angle, gauge block, etc.	April 7-18, 2014 (2 weeks)	***16*** ***(11 countries)***
GMA-GT-2014-03 **TH**	**Thermometry and Humidity** SPRT (contact) Thermometry; Radiation (non-contact) Thermometry;	June 9-20, 2014 (2 weeks)	***24*** ***(16 countries)***

Course begins with a session of metrology in general (MiG), presenting QMS, uncertainty in measurement, and national standards system.

For an effective performance, each laboratory session delivers technical lectures combined with practices to follow.

GROUP COURSES 2014: PROGRAM OVERVIEW

Metrology in Mass & Related Quantities [GMA-GT-2014-01-MRQ]

Participants: 22 people from 12 countries

Bangladesh	NML-BSTI	2	Philippines	NML-ITDI	2
Hong Kong	SCL	1	Vietnam	QUATEST 3	2
Indonesia	KIM-LIPI	2	Zambia	ZABS	1
Kenya	KEB	1	Zimbabwe	NMI-SIRDC	1
Mongolia	MASM	2	Sub-TOTAL (from abroad)	9 Countries	15 People
Ethiopia	NMIE (UST student)	2	Philippines	NML-ITDI (UST student)	1
Indonesia	KIM-LIPI (UST student)	1	Sri Lanka	MUSSD (UST student)	1
Korea	KRISS	2	Sub-Total (within KRISS)	3	7
			TOTAL	**12 countries**	**22 people**

Asia	16/8 countries
Africa	6/4 countries

- KRISS: newly recruited researchers

KRISS

GROUP COURSES 2014: PROGRAM OVERVIEW

GMA_GT_ 2014-01-MRQ	Subjects	Time slots allocated
MiG	Metrology in General	2.5 days (including evaluation)
	Presentation of Action Plans	0.5 day (presentations followed by Q&A)
Metrology in MRQ Mass and Related Quantities	MRQ-01: Mass MRQ-02: Density MRQ-3: Pressure MRQ-04: Force and Torque	6.5 days (technical lectures plus hands-on practice, wrap-up discussion)

Intensive Laboratory Session (Mass, Density)

Intensive Laboratory Session (Force, Torque)

Are you ready? Time to start!

Intensive Laboratory Session (Pressure)

KRISS GMA choir singing "A-ri-rang," a traditional love song of Korea~

Carpe-diem! Never say good-bye, it's just for a farewell~

GROUP COURSES 2014: PROGRAM OVERVIEW

Metrology in Length & Dimensional Measurement [GMA-GT-2014-02-LDM]

Participants: 16 people from 11 countries

Bangladesh	NML-BSTI	2	Malawi	MBS	1
China	NIM	1	UAE	EMI	2
Egypt	NIS	2	Vietnam	QUATEST 3	1
Hong Kong	SCL	1	Zambia	ZABS	2
Indonesia	KIM-LIPI	2	Sub-TOTAL (from abroad)	10 Countries	15 People
Kenya	KEBS	1	Sub-Total (within KRISS)	1	1
Korea	KRISS	1	**TOTAL**	**11 Countries**	**16 people**

Asia	8/6 countries
Africa	4/3 countries
Mid-East	4/2 countries

- KRISS: newly recruited researchers

GROUP COURSES 2014: PROGRAM OVERVIEW

GMA_GT_ 2014-02-LDM	Subjects/Modules	Time slots allocated
MiG	MiG: Metrology in General	2.5 days (including evaluation)
	Presentation of Lab Reports & Action Plans	1.25 days (presentations followed by Q&A)
	Evaluation Test	0.25 day
Metrology in LDM Length and Measurement	LDM-01: Length standards LDM-02: Angle, Straightness, Flatness, Squareness LDM-03: Gauge block, EDM LDM-04: Length measuring instruments LDM-05: Surface texture, Laser dimensional measurement	5.5 days (technical lectures plus hands-on practice, Individual lab visits)

"For whom to measure the angles?"

"Quo Vadis, NSS!"

Make certain uncertainty in your measurements!

"Take care! No one be missed ^*^"

KRISS

GROUP COURSES 2014: PROGRAM OVERVIEW

Metrology in Thermometry & Humidity [GMA-GT-2014-03-TH]

Participants: 24 people from 16 countries

Botswana	BOBS	1	South Africa	NMISA	1
Colombia	INM	2	Sri Lanka	MUSSD	1
Hong Kong	SCL	1	Trinidad and Tobago	TTBS	2
Indonesia	KIM-LIPI	1	UAE	EMI	1
Malawi	MBS	1	Vietnam	QUATEST 3	2
Philippines	NML-ITDI	2	Zambia	ZABS	2
	YANA	2			
Saudi Arabia	GSO-GCC	1	Sub-TOTAL (from abroad)	13 Countries	20 People
Egypt	NIS (Ph.D. student)	1	Mongolia (UST student)	MASM	1
Korea	KRISS	1	Sub-Total (within KRISS)	3	4
Indonesia	KIM-LIPI	1	**TOTAL**	**16 Countries**	**24 People**

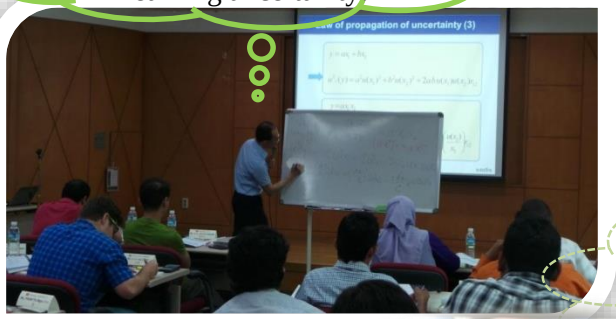
Asia	12/7 countries
Africa	5/4 countries
Mid-East	3/3 countries
South America	4/2 countries

GROUP COURSES 2014: PROGRAM OVERVIEW

GMA_GT_ 2014-03-TH	Subjects/Modules	Time slots allocated
MiG	MiG: Metrology in General	2.5 days (including evaluation)
	Presentation of Action Plans	0.5 day (presentations followed by Q&A)
Metrology in TH Thermometry and Humidity	TH-01: SPRT Thermometry TH-02: Radiation Thermometry TH-03: Humidity and Moisture	6.5 days (technical lectures plus hands-on practice, Individual lab visits for wrap-up discussion)

The early birds catching the chance, given only once~

"Practice makes perfect!" There is no royal road to learning uncertainty!



"While in Korea, do as Koreans do!" Time to enjoy "Bi-bim-bap," the steamed rice mixed with collections of fresh vegetables, savored with sesame oil and red-pepper paste!

Realizing the TPW, triple points of water! *Yes, it is POSSIBLE !*

2014 FIFA World Cup Brazil!

Another group of early birds getting together at KRISS in support of the Korean national team vs Russia!

INDIVIDUAL COURSES

Tailored to meet the specific needs of our partners

Experimental study for dissertation

Expanding scope of services

Building up new CMCs

Beginning a career as metrologist

INDIVIDUAL COURSES 2013: OVERVIEW

Beneficiaries
nine (9) people
from six (6) countries

61 person- weeks
in five areas of
physical metrology

Areas (number of participants)	Countries	Employers	Dates
Length (1)	Lithuania	Vilnius Gediminas Technical University	Mar 31-Jun 2 (9 weeks)
Length (2)	Pakistan	National Physical and Standards Laboratory (NPSL)	Jun 3-Jun 15 (2 weeks)
Thermometry (1)	Syria	National Standards and Calibration Laboratory (NSCL)	Jun 30-Jul 12 (2 weeks)
Gas Analysis (1)	Singapore	National Metrology Center, A*STAR (NMC/A*STAR)	Jun 30-Aug 31 (9 weeks)
Length (1)	Lithuania	Vilnius Gediminas Technical University	Oct 1-Nov 30 (9 weeks)
Fluid Flow (2)	The Philippines	National Metrology Laboratory – ITDI (NML-Phil)	Nov 3-Nov 16 (2 weeks)
Acoustics & Vibration (1)	Vietnam	Vietnam Metrology Institute (VMI)	Nov 8 - (24 weeks)

INDIVIDUAL COURSES 2014: OVERVIEW

Areas (number of participants)	Countries	Employers	Dates
Length (1)	Lithuania	Vilnius Gediminas Technical University	Jan 8 – May 30, **(21 weeks)**
Electricity (1)	Malaysia	National Metrology Laboratory (NML)-SIRIM	May 1- Aug 31 (**18 weeks**)
Magnetism (1)	Malaysia	National Metrology Laboratory (NML)-SIRIM	May 1- Aug 31 (**18 weeks**)
Thermometry (1)	South Africa	National Metrology Institute of South Africa (NMISA)	June 23-July 5, (2 weeks)
Ionizing Radiation (3)	Indonesia	BATAN	Dec 1-24 (**3.5 weeks**)

seven (7) people from four (4) countries

67.5 person-weeks covering fundamental areas of metrology

KRISS-UST GRADUATE SCHOOL OF METROLOGY

As of Jul 2014	Doctoral course	Master's course	Total	From NMI (& DI)
Graduates	7	7	14	10
In Progress	12	4	16	13
Total	19	11	**30**	**23**

OUTREACH SERVICES

Services on site of customers abroad...

Its competitive advantages ..... a more **comprehensive approach**...

from diagnosis to prescriptions

...

dealing with not only **technical but also strategic** issues...

Beneficiaries spread

...

widely over the national metrology community of the customers.

Competitive Advantages of Outreach Services

Comprehensive Approach

From Diagnosis

To Prescriptions

Diverse Activities

Fact-finding Survey

Lectures and advice

Technical Training

Wide Range of Beneficiaries

Nationwide Community of Metrology

NMI, Calibration/Testing Labs, Government, etc.

WE'VE DONE FOR EFFECTIVENESS

❑ **Close partnership**
- GMA-Participants-Lecturers
- Sharing information
- Finding solutions to problems faced
- Social events

❑ **Interactive classes**
- Two-way communications between Lecturers and participants
- Clear understanding of needs/problems
- Better understanding of knowledge in subject metrology areas

❑ **Technical Study**

+ PLUS +

❑ **"Metrology in General" in Essence**
- Lectures on NQI, CIPM MRA, QMS, Measurement uncertainty

➔ **Macroscopic perspectives** required to be future leaders of metrology communities both at local and global levels

❑ **Financial resources shared**
- **KRISS**
- **UNIDO** (✓)
- PTB

✓*KRISS is a privileged partner of UNIDO.*

❑ **Global/Regional network provided:** websites/members
- BIPM, DCMAS
- APMP, SIM, COOMET, AFRIMETS

KRISS

IN PURSUIT OF HIGHER PERFORMANCE *through problem-solving* GMA *approach*

Analysis of Lab Reports

⬇

Modifications of Practices

Lectures & Practices PLUS Individual Lab Visits

Substantial Action Plans Developed

❑ **Lab Reports**
- Written by ALL participants
- Analyzed by GMA
- Needs/Problems identified
- Practices rearrangements

➔ **to best meet practical needs**

❑ **Effective Learning**
- Lectures (AM) +
- Practice (PM)

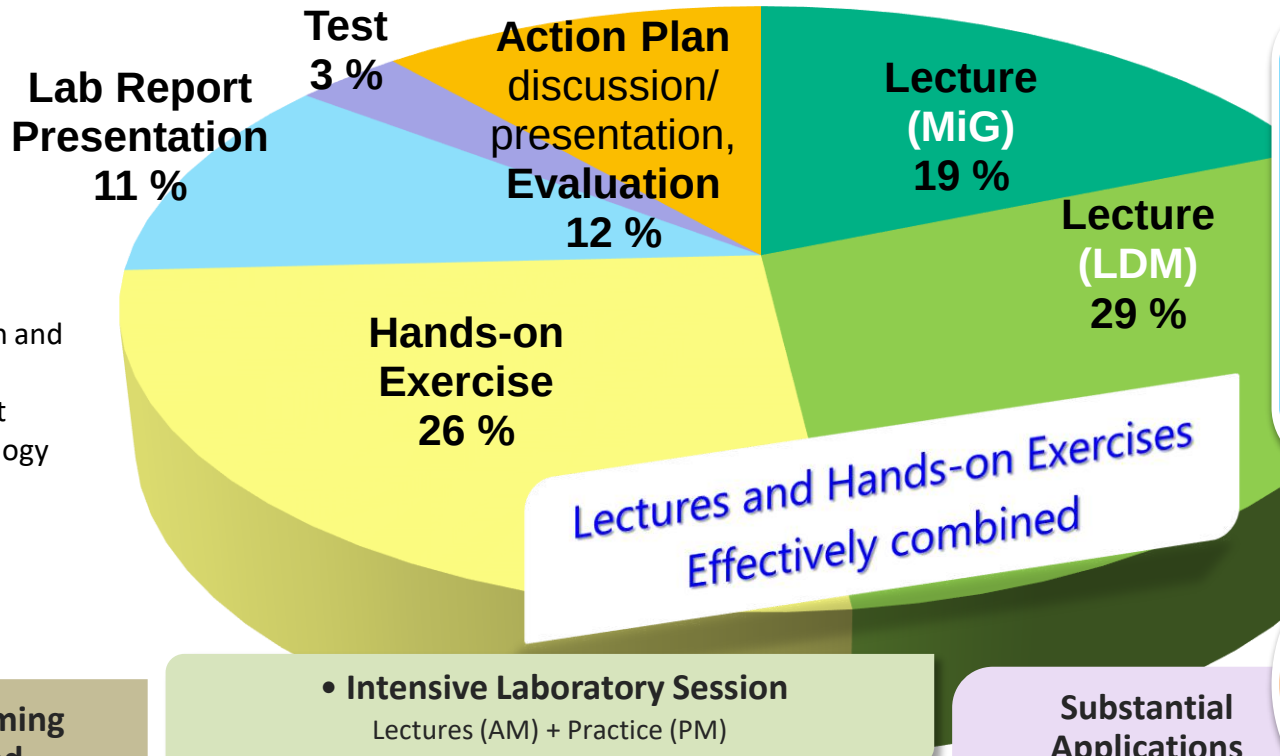
❑ **Individual Lab Visits Added**
- On the last day of each group course, following wrap-up discussion
- Individual participants visit laboratories of further interest

❑ **Action Plans**
- Draft action plans written by ALL participants before the course
- Obtaining advice of the lecturers during the course
- ALL participants are refining their **Action Plans to be more substantial/practical**

KRISS

IN PURSUIT OF HIGHER PERFORMANCE

creating high-level of customer satisfaction



- **LDM:** Length and Dimensional Measurement
- **MiG:** Metrology in General

Content Composition of a GMA Group Course (2014)

Lectures and Hands-on Exercises Effectively combined

- **Intensive Laboratory Session**
  Lectures (AM) + Practice (PM)
- **Action Plan Development**
  solutions to problems in face, future development plan
- **"Metrology in general" incorporated**
  Lectures on NQI, CIPM MRA, QMS, Uncertainty

Programming Focused on a most effective learning

Substantial Applications for better services on site

Customer Satisfaction higher than 4.5/5.0

CONTENTS

GMA GROUP COURSES 2015
(PROVISIONAL)

Technical Course (1)
FF (Fluid Flow)

Technical Course (2)
RI (Ionizing Radiation)

GMA GT 2015 Themes of Courses

Technical Course (3)
? (to be confirmed)

Metrology in General (MiG)

MiG welcomes QS Managers, NMI Directors, high-officials of government in charge of national measurement system

For inquiry regarding the course information, please contact:
Mr. Sangwook Seo, senior project manager/GMA at swseo@kriss.re.kr, with attention to
Dr. Gyeong Hee Nam
ghnam@kriss.re.kr
Head, of GMA.

Tuition Fee: paid by participants (US$500, US$1,000)

Local Transportation, Lunch, Hotel Accommodations might be supported by KRISS for selected participants from developing countries

KRISS

1 **KRISS at a Glance**
- *national metrology institute (NMI) of Korea*

2 **Partnership with Industry and Academia**
- *Measurement Clubs, Home Doctors, Technology Transfer*
- *Metrology Research Centers (MRCs)*

3 **Government Role in Advancing S&T and Metrology**
- *for sustainable economic growth: case study for Korea*

4 **GMA in Brief**
- *achievements and plan*

5 **Lessons Learned**
- *and recommendations*

LESSONS LEARNED (1-NMI)

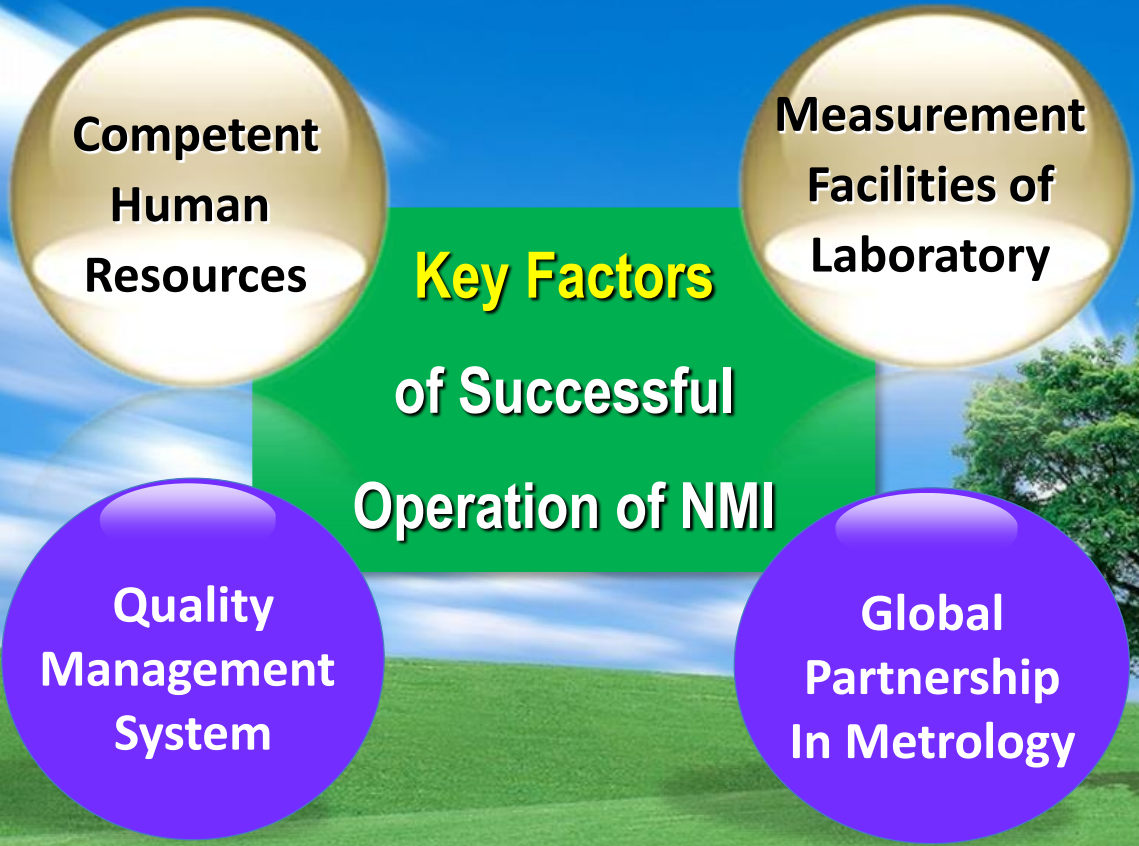
Primary mission of NMI

Serving customers

with internationally recognized capability of measurement standards by effectively participating in the the CIPM MRA activities

- **Quality Management System**
- **Advanced R&D Capabilities**
- **Global Partnership In Metrology**

LESSONS LEARNED (2-NMI)



LESSONS LEARNED (3-NMI)

Investment To be focused on

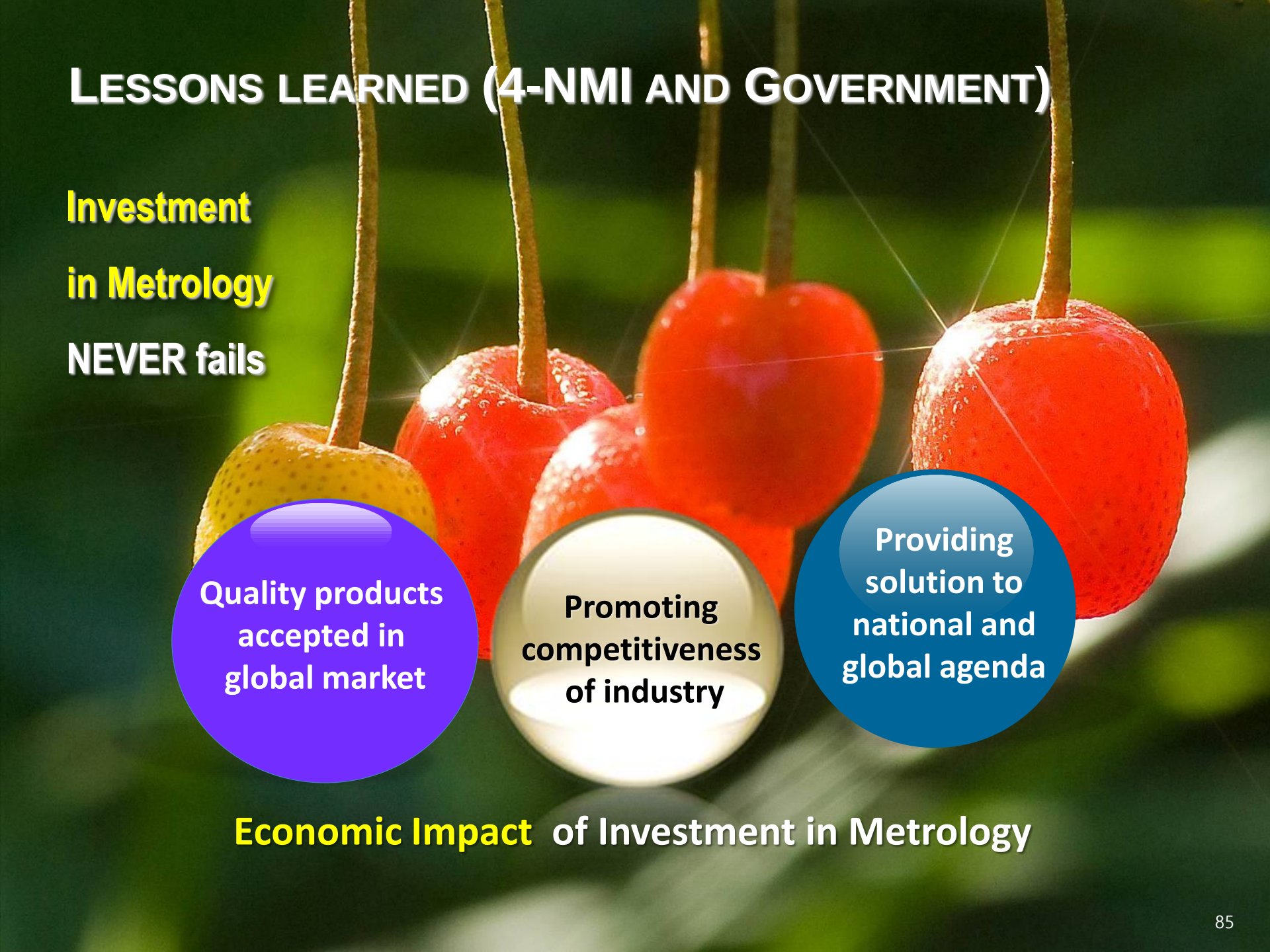
People	Facility	QMS
Competent HRD In Metrology	Advanced Measuring Facility	QMS To International Standards

LESSONS LEARNED (4-NMI AND GOVERNMENT)

Investment

in Metrology

NEVER fails



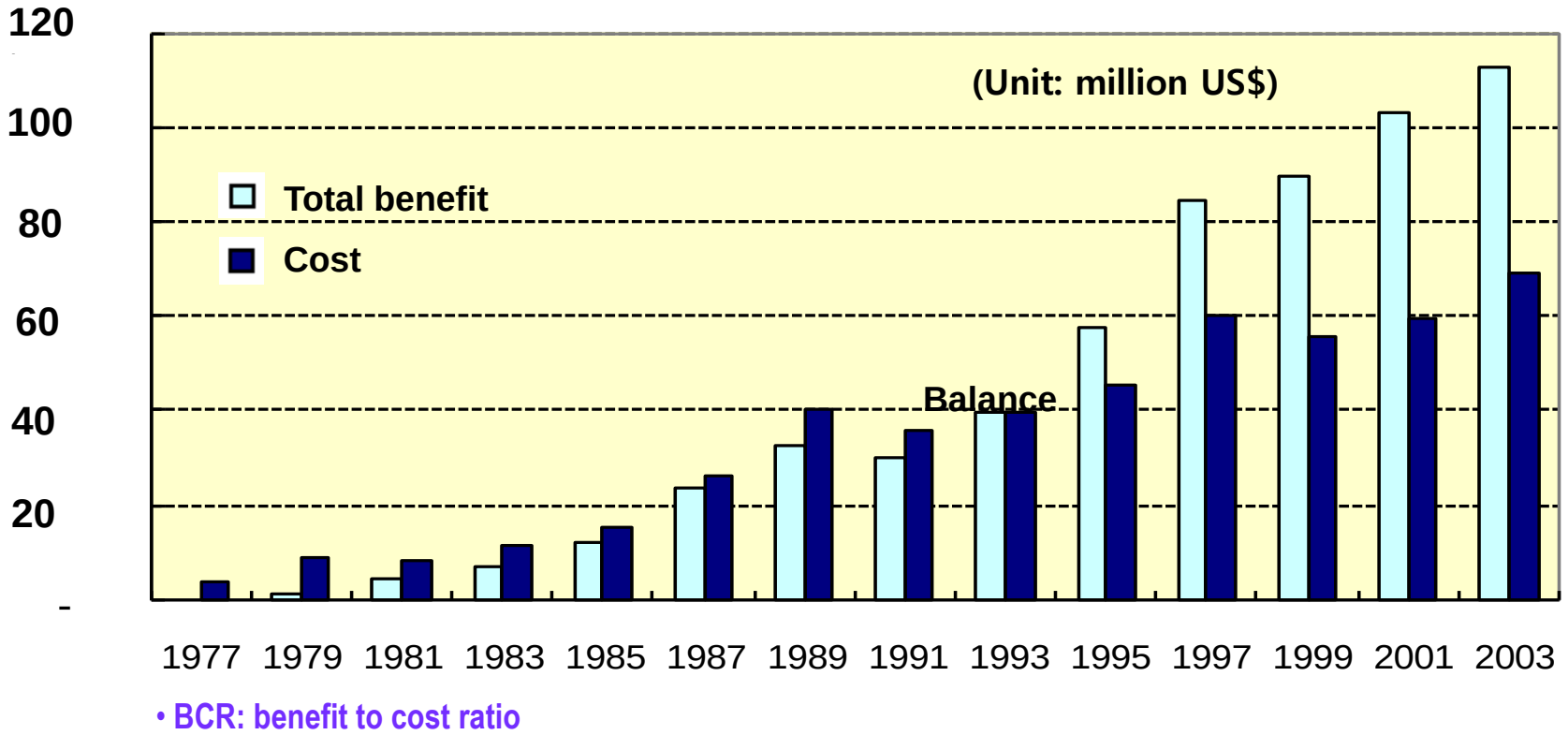
Economic Impact of Investment in Metrology

KRISS Contribution to National Economy

q **Direct Value created** : US$ 860 mil (for 10 years of 1994-2003), **BCR of 1.5**

(Data : Revenue from calibration/testing and CRM services for 10 years: 1994-2003)

- **Economic Impact** : US$ 812 mil, **BCR of 12.76** (FY 2003 budget of $ 63.7 mil)
- Data prepared/analyzed : Bearing Point, Inc. (Jul. 2004)



• BCR: benefit to cost ratio

RECOMMENDATION: GOVERNMENT

KRISS

Significant Synergy Effect
With higher efficiency

National Development Planshould include

Strategic planning and investment

On METROLOGY

Metrological Capability
to be promoted

National Quality Infrastructure
to be advanced

NMI's Role
to be expanded in national and regional community

Photographed by Yong Ki Park


KRISS
GMA
The Most Friendly,
The Most Productive Partner
Sharing Fruits of Shared Efforts
Partnership Raises us
Up to More & Better than
One can Do alone!


감사합니다!
Gam-sa-ham-mi-da!
2002 FIFA WORLD CUP KOREA JAPAN
Dreams come true!
KOREA KRISS did it, and now
Colombia INM can do it.
Muchas
Gracias!
Partnership in Metrology
raises all Partners up to
more and better than one can do alone

GMA

GMA
pursues to be
a most productive & friendly partner
for HRD in metrology
in the spirit of
sharing the fruits of shared efforts!

Gyeong-Hee NAM, Ph.D.
Head, GMA
ghnam@kriss.re.kr

Jong-Oh CHOI, Ph.D.
Chief Professor
choijongoh@kriss.re.kr

Jiseung YOO
Coordinator, Local Programs
jiseung.yoo@kriss.re.kr

Sangwook SEO
Senior Coordinator, Global Programs
swseo@kriss.re.kr

KRISS

Appendix (1)
CIPM MRA Success Stories of KRISS in Korea

KRISS and MRA, Joining the CIPM MRA in 1999

KRISS

Reconnaissance mutuelle
des étalons nationaux de mesure
et des certificats d'étalonnage et de mesurage
émis par les laboratoires nationaux de métrologie
Paris, le 14 octobre 1999
Supplément technique révisé en octobre 2003 (pages 17-20)

Mutual recognition
of national measurement standards
and of calibration and measurement certificates
issued by national metrology institutes
Paris, 14 October 1999
Technical Supplement revised in October 2003 (pages 38-41)

Comité international des poids et mesures

Bureau international des poids et mesures
Organisation intergouvernementale de la Convention du Mètre

RECONNAISSANCE MUTUELLE
DES ÉTALONS NATIONAUX DE MESURE
ET DES CERTIFICATS D'ÉTALONNAGE ET DE MESURAGE
ÉMIS PAR LES LABORATOIRES NATIONAUX DE MÉTROLOGIE

Arrangement rédigé par le Comité international des poids et mesures (CIPM) en vertu de l'autorité qui lui est conférée par les États membres de la Convention du Mètre

MUTUAL RECOGNITION
OF NATIONAL MEASUREMENT STANDARDS
AND OF CALIBRATION AND MEASUREMENT CERTIFICATES
ISSUED BY NATIONAL METROLOGY INSTITUTES

Arrangement drawn up by the International Committee of Weights and Measures under the authority given to it in the Metre Convention

Ce document sera soumis à la signature des directeurs des laboratoires nationaux de métrologie (LNM) des États membres de la Convention du Mètre, à partir du 14 octobre 1999, date de leur réunion à l'occasion de la 21e Conférence générale des poids et mesures.

This document will be open for signature by directors of the national metrology institutes (NMIs) of the Member States of the Metre Convention starting from 14th October 1999, at a meeting of directors that will take place on the occasion of the 21st General Conference of Weights and Measures.

Nom/*Name* Signature	LNM/*NMI**	État/*State*	BIPM Signature
Myung Sai chung	KRISS	Rep. of Korea	

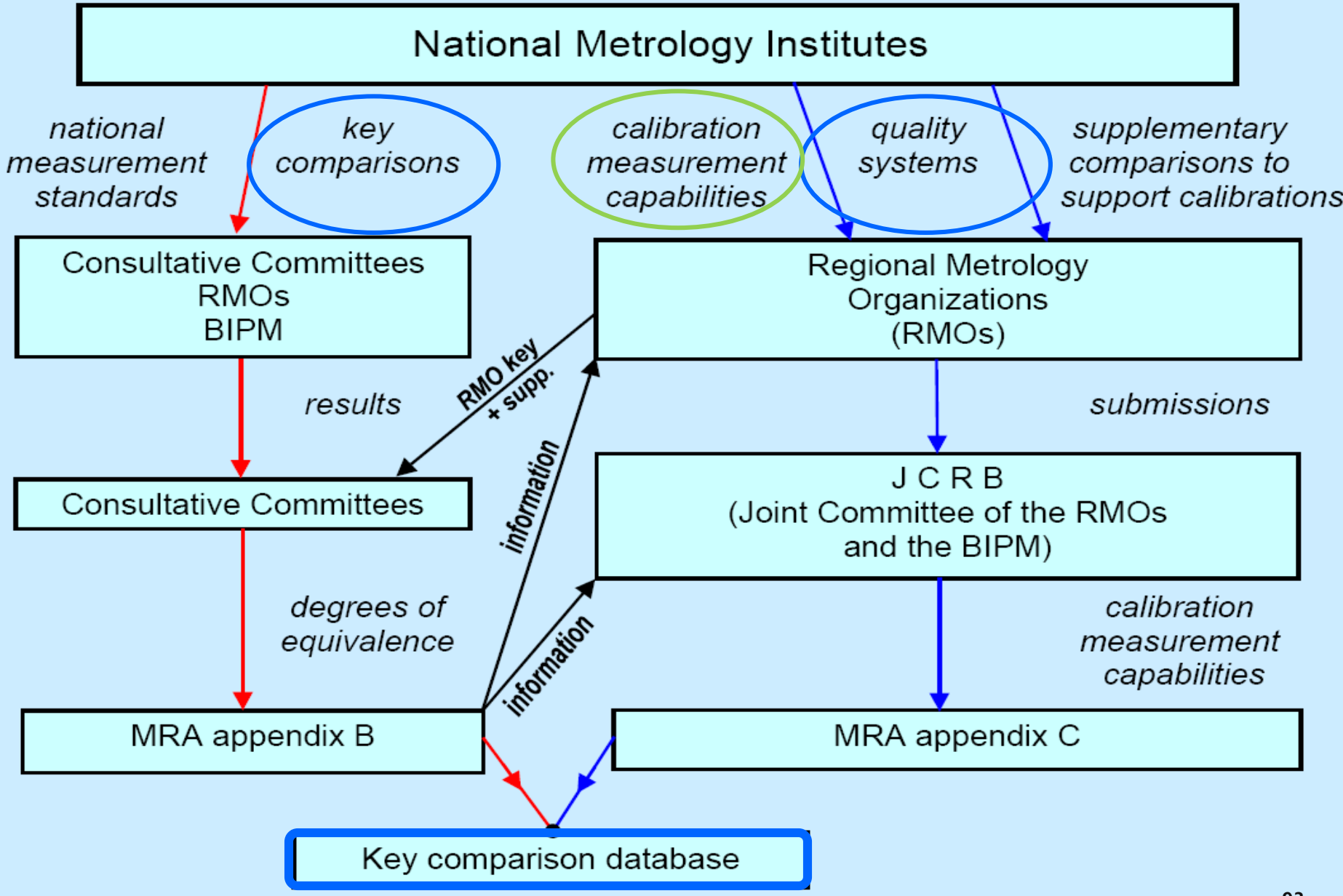
*Tous les laboratoires et instituts mentionnés dans cette colonne participent à cet arrangement.
This arrangement covers all the institutes listed here.

KRISS, one of the signatories to the MRA in Oct 1999

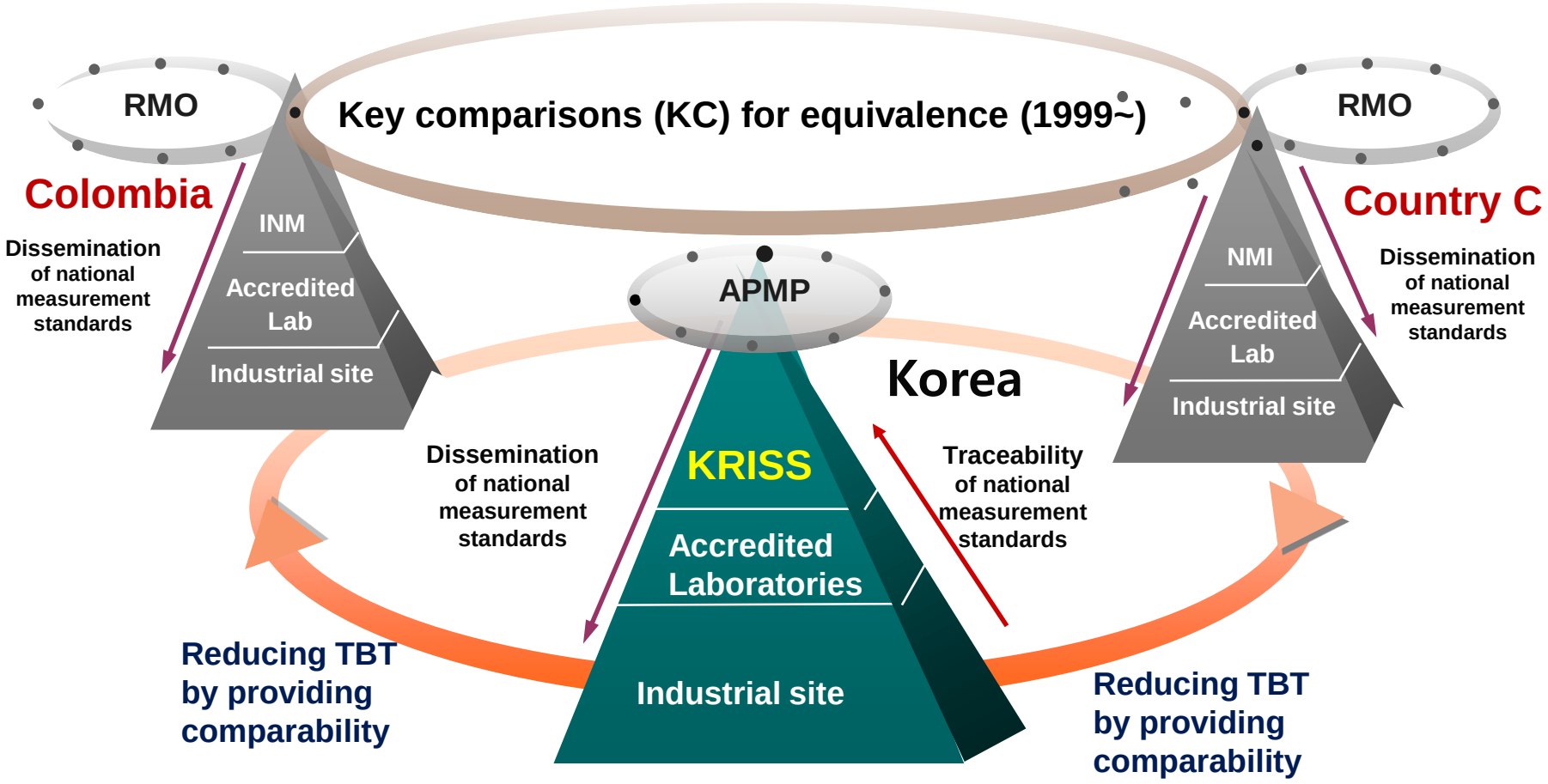
Signatories

38 countries+ 2 Int'l org.	92 countries + 4 Int'l org
(IAEA, IRMM)	(IAEA, IRMM, WMO, ESA)
Oct 1999	Oct 2014

Running Two Tracks of CIPM-MRA



CIPM MRA (Oct 1999)



- RMO: Regional Metrology Organization
- TBT: Technical Barriers to Trade
- APMP: Asia-Pacific Metrology Programme

☞ **MRA Signatories (96 institutes) :** 53 Member states, 39 Associates, 4 international organizations

Participation in KC, Key Comparisons
CMC Registration, Calibrations and Measurement Capabilities

Field	AUV 음향 진동	EM 전자기	L 길이	MRQ 질량	PR 광도 복사도	QM 물질량	RI 전리 방사선	T 온도	TF 시간 주파수	Total
KC	20	56	23	67	19	104	58	25	1	373
CMC	41	141	41	49	41	519	214	69	24	1139

BIPM KCDB (http://kcdb.bipm.org/ Feb 2014)

Country	USA	Russia	Germany	China	UK	Korea	Japan
CMC	2180	1598	1541	1248	1194	*1139*	1095

Country	Germany	USA	UK	Japan	France	KRISS
KC	644	473	460	438	430	*373*
KC-PL	164	110	100	84	49	62

PL: Pilot Laboratory

Equivalence by Key Comparison

(Results of ALL KCs made public at http://kcdb.bipm.org/)

Bureau International des Poids et Mesures

Home | Key and supplementary comparisons | Calibration and Measurement Capabilities - CMCs

Home > Comparisons Search > Results of the search > CCM.F-K4.a results

Key and supplementary comparisons - Results

KCDB

CCM.F-K4.a

- Information
- Pilot / Contact
- Participants
- Results
  - Force 2 MN
  - Force 4 MN
- Print out

Related links

- KCDB Statistics
- KCDB FAQs
- KCDB Reports
- CIPM MRA
- JCRB
- Find my NMI
- Metrologia

Contact us

- BIPM.KCDB@bipm.org

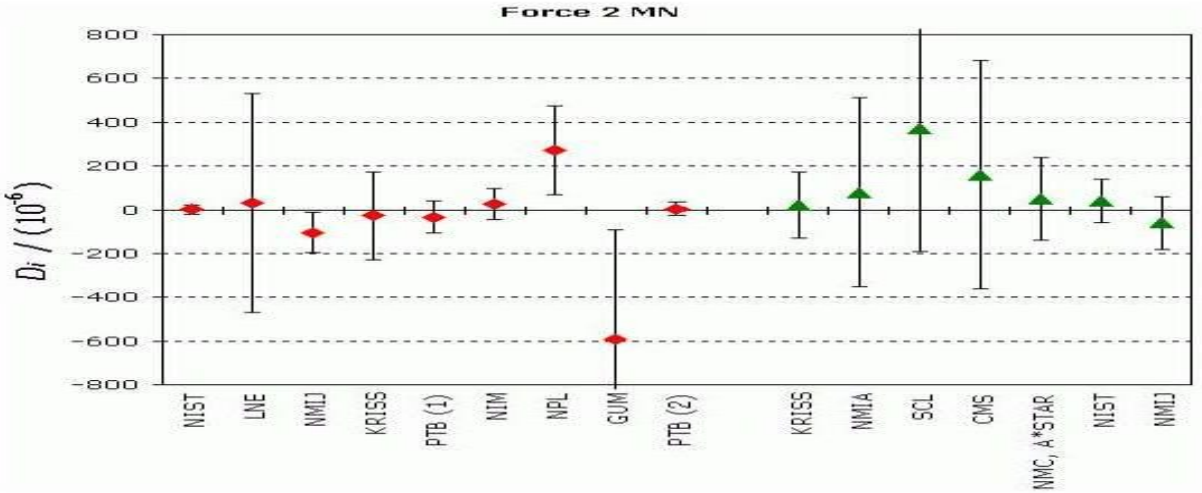
Results

Laboratory individual measurements | Equivalence statements | Degrees of equivalence | Graph(s) of equivalence

CCM.F-K4 and APMP.M.F-K4.b

MEASURAND : Force
NOMINAL VALUE : 2 MN

Degrees of equivalence D_i and expanded uncertainty U_i ($k = 2$) expressed in 10^{-6}



PTB (1) : 16.5 MN-K-NME machine
PTB (2) : 2 MN-K-NME machine

Red diamonds : participants in CCM.F-K4
Green triangles : participants in APMP.M.F-K4.b

Top of the page

CMC Table

(CMC, Calibration and Measurement Capability) made public to customers at http://kcdb.bipm.org/)

Calibration and Measurement Capabilities

Mass and Related Quantities, Republic of Korea, KRISS (Korea Research Institute of Standards and Science)

KCDB

Calibration or Measurement Service			Measurand Level or Range			Measurement Conditions/Independent Variable		Expanded Uncertainty						
Class	Instrument or Artifact: Measurand	Instrument Type or Method	Minimum value	Maximum value	Units	Parameter	Specifications	Value	Units	Coverage factor	Level of Confidence	Is the expanded uncertainty a relative one?	Comments	NMI internal service identifier
Mass	Mass standard	Comparison in air	1	1	kg			28	µg	2	95%	No	Approved on 02 October 2014	C2011622
Mass	Mass standard	Comparison in air	1	100	mg			0.6	µg	2	95%	No	Approved on 02 October 2014	C2011621
Mass	Mass standard	Comparison in air	0.1	1	g			0.6 to 0.7	µg	2	95%	No	Approved on 02 October 2014	C2011621
Mass	Mass standard	Comparison in air	1	10	g			0.7 to 3	µg	2	95%	No	Approved on 02 October 2014	C2011621
Mass	Mass standard	Comparison in air	10	100	g			3 to 5	µg	2	95%	No	Approved on 02 October 2014	C2011621
Mass	Mass standard	Comparison in air	0.1	1	kg			5 to 28	µg	2	95%	No	Approved on 02 October 2014	C2011621, C2011622
Mass	Mass standard	Comparison in air	1	20	kg			28 to 4000	µg	2	95%	No	Approved on 02 October 2014	C2011622, C2011623
Mass	Mass standard	Comparison in air	20	100	kg	Mass	20 kg, 50 kg and 100 kg	4 to 50	mg	2	95%	No	Approved on 02 October 2014	C2011624, C2011625
Mass	Mass standard	Comparison in air	100	1000	kg	Mass	100 kg, 200 kg, 500 kg and 1000 kg	0.05 to 5	g	2	95%	No	Approved on 02 October 2014	C2011625
Density (solid)	Glass and sphere	Fundamental hydrostatic weighing	100	1000	g	Temperature	(10 to 30) °C	0.019 to 0.002	kg/m³	2	95%	No	Approved on 02 October 2014	C20703
Density (solid)	Stainless steel weight	Fundamental hydrostatic weighing	100	1000	g	Temperature	(10 to 30) °C	0.25 to 0.073	kg/m³	2	95%	No	Approved on 02 October 2014	C20703
Density (solid)	Stainless steel weight	Precision hydrostatic weighing	1	50	g	Temperature	(10 to 30) °C	6.6 to 1.3	kg/m³	2	95%	No	Approved on 02 October 2014	C20703
Density (solid)	Stainless steel weight	Precision hydrostatic weighing	0.2	0.5	g	Temperature	(10 to 30) °C	35 to 11	kg/m³	2	95%	No	Approved on 02 October 2014	C20703
Density (liquid)	Liquid	Hydrostatic weighing	600	2000	kg/m³	Temperature	(10 to 30) °C	0.005	kg/m³	2	95%	No	Approved on 02 October 2014	C20702
Density (liquid)	Hydrometer	Cuckow's method	605	1990	kg/m³	Temperature	(15 to 20) °C	0.024 to 0.073	kg/m³	2	95%	No	Approved on 02 October 2014	C20706, C20710
Volume (static)	Glasswares and volume tank	Gravimetric	1	20000	ml	Temperature	(15 to 25) °C	0.012 to 0.44	ml	2	95%	No	Approved on 02 October 2014	C20601, C20607
Volume (static)	Volume tank	Gravimetric and volumetric	100	1000	L	Temperature	(15 to 25) °C	16 to 220	ml	2	95%	No	Approved on 02 October 2014	C20606

The BIPM key comparison database, October 2014 1/6

CIPM MRA Success Story in Korea (1)

KRISS

DSME, Korea – BP, USA [2002]

- *DSME: Daewoo Shipbuilding & Marine Engineering*
- *BP: British Petroleum*

Claim

- Offshore plant order by BP,USA.
- Calibration traceable to NIST required.

Solution

- DSME, accredited by KOLAS, a member of ILAC MRA.
- DSME, keeping traceability of its standards to KRISS.
- KRISS and NIST are all signatory to the CIPM MRA.
- NIST confirmed that "traceability to KRISS is equivalent to traceability to NIST" via the CIPM MRA.
- BP accepted accreditation by KOLAS and calibration certificates issued by KRISS.

< DSME offshore plant >

Benefit

- Saved 11 Million US$
  - recalibration at NIST; US$ 1 million
  - penalty of 2 month delay; US$ 10 million

CIPM MRA, ILAC MRA → *Coming over technical barrier* to trade → *Economic benefits* to global enterprise

For more: www.bipm.org/en/bipm/int/impact-studies.html

CIPM MRA Success Story in Korea (2)

SHI - SEIC, Russia [2003]

- *SHI : Samsung Heavy Industry*
- *SEIC : Sakhalin Energy Investment Company*

Claim

- SHI constructing an offshore platform ordered by SEIC, Russia.
- All the measuring instruments installed in the platform required to be traceable to NMS of Russia.

Solution

- KRISS and VNIIMS participate in the CIPM MRA.
- KRISS and VNIIMS concluded a protocol recognizing the equivalence of NMS of both countries.
- SEIC approved all the measuring instruments of SHI traceable to KRISS as traceable to VNIIMS.

Benefit

- US$ 16 million saved
- US$ 150,000 Invested for calibration

< The dimensions of the platform is approximately 95 m x 130 m x 120 m >

Had it not been for the CIPM MRA…

- Additional 3 months of delivery & Calibration;
- Possible penalty due to delay of delivery: US$ 16 million

CIPM MRA Success Story in Korea (3)

POSCO – India, Mexico [2004]

• *POSCO: Pohang Steel and Iron Company*

Claim

- Mexican manufacturer of automobile parts demanded the proof of reliability of POSCO steel.
- Indian buyer of POSCO steel required the certification from BIS (Bureau of India Standard).

Solution

- POSCO's testing laboratory , accredited by KOLAS.
- KOLAS is a member of APLAC, and ILAC MRA.
- POSCO has a traceability to KRISS participating in the CIPM MRA.
- POSCO's steel accepted without being retested.

Benefit

- Saved 5 Million US$

< POSCO steel plant >

Had it not been for the CIPM MRA, ILAC MRA, …

- Cost in transportation/retesting at Mexican and Indian lab's
- Cost due to delay in delivery

CIPM MRA Success Story in Korea (4)

Korean Air - US FAA [2008]

Claim

- According to US Repair Station Act, US FAA required KA to secure calibration certificates traceable to NIST.

Solution

- KRISS and NIST participate in the CIPM MRA;
- FAA accepted all the KA measuring instruments traceable to KRISS as traceable to NIST.

Benefit

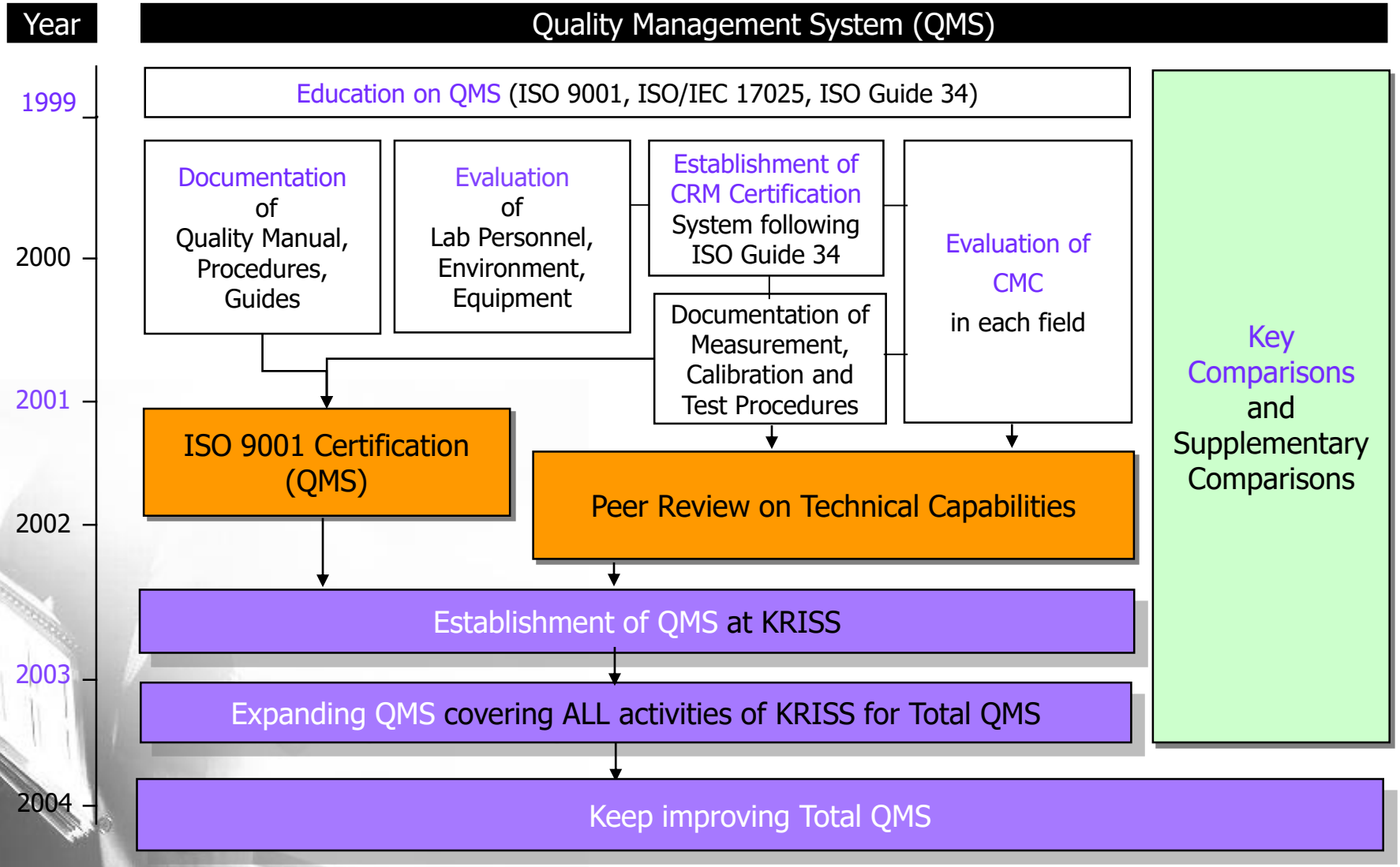
- Saved 9.4 Million US$

< Korean Air >

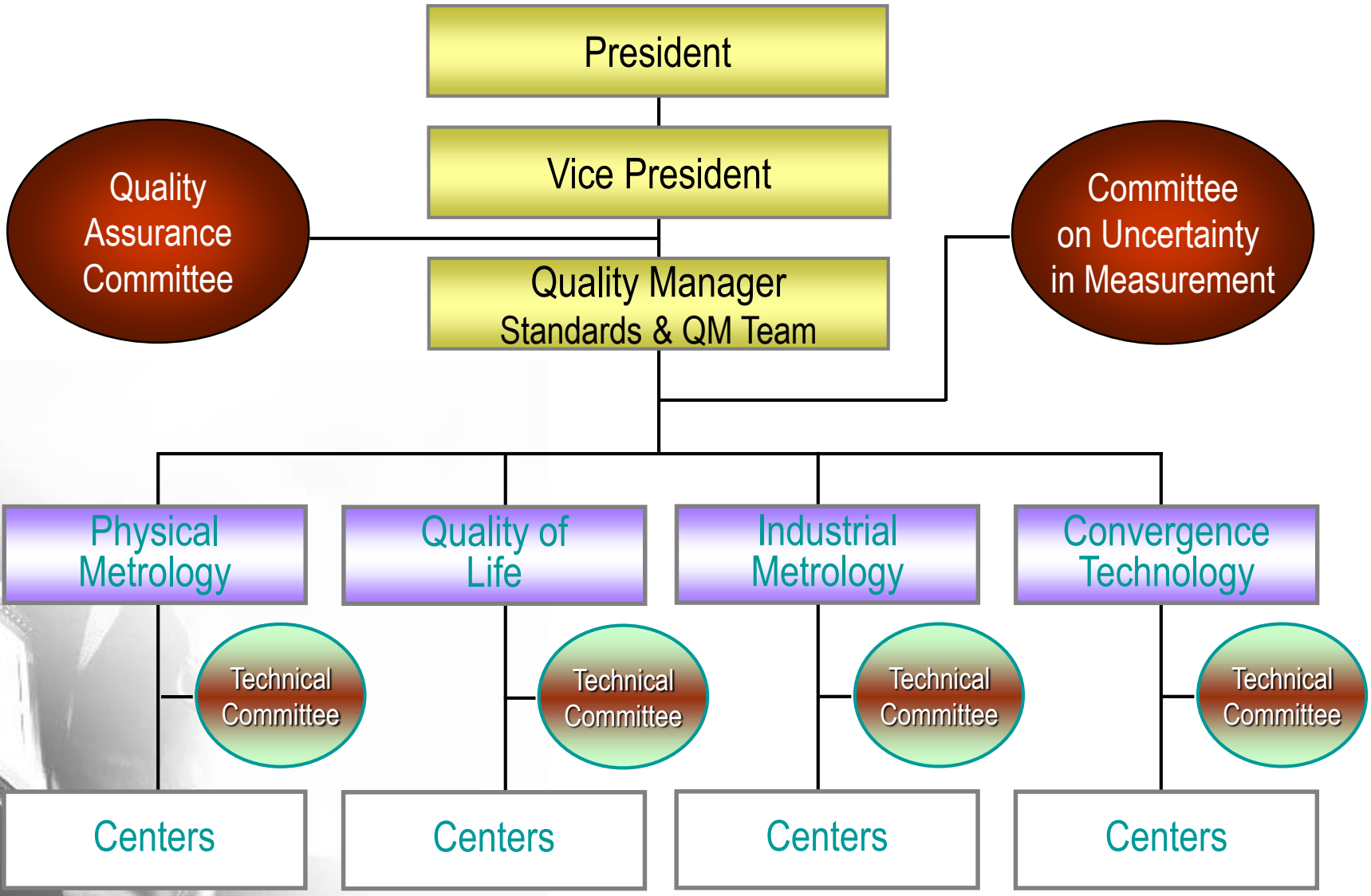
Had it not been for the CIPM MRA,

- Suspending services for 3 months while calibrated at NIST; or
- Additional cost to substitute instruments; and to establish a new system with traceability to NIST.

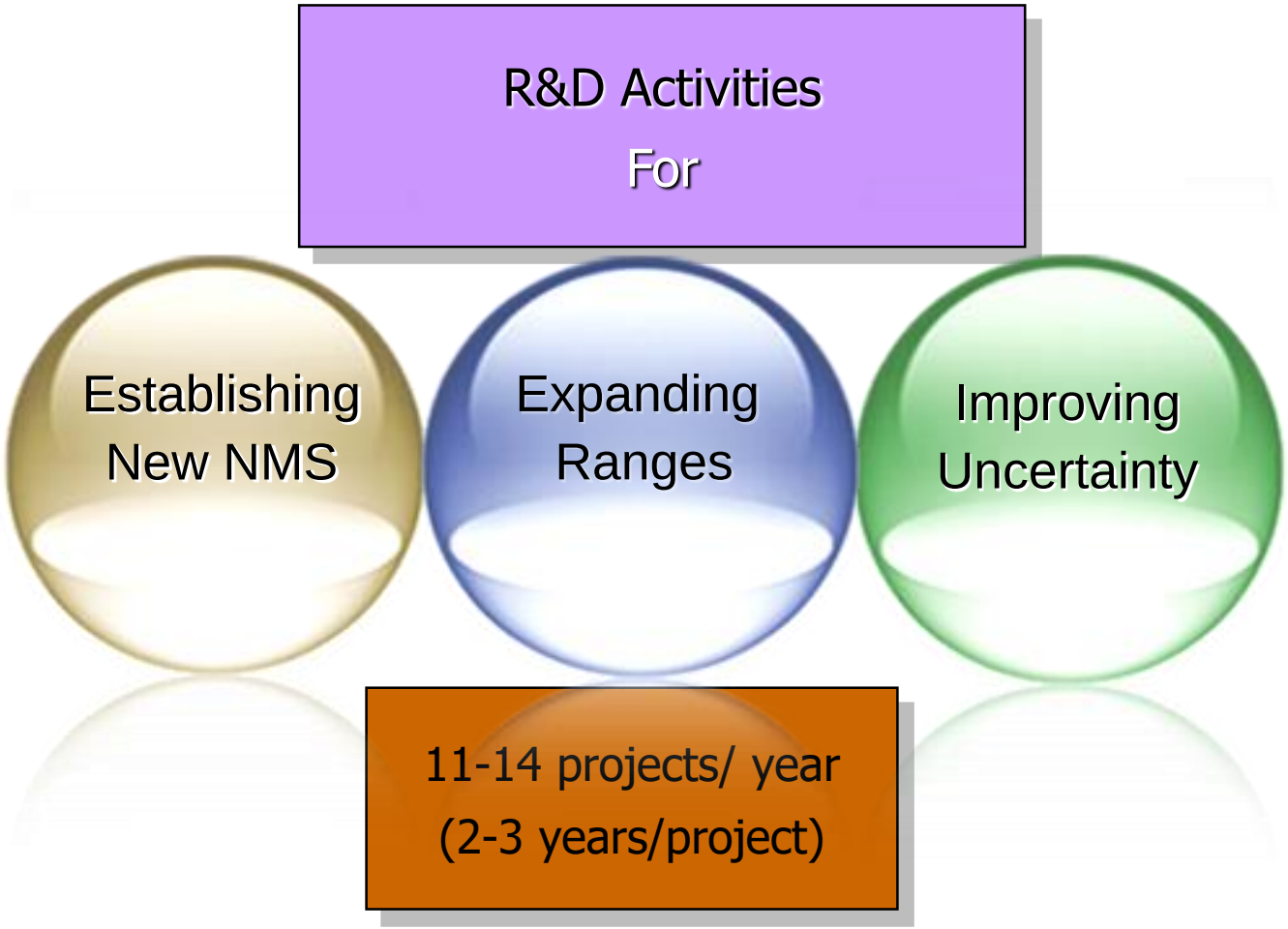
FOR QMS-CIPM MRA: ROADMAP



FOR QMS-CIPM MRA: OPERATING UNITS



FOR QMS-CIPM MRA: SPECIFIC R&D



FOR QMS-CIPM MRA: QMS CERTIFIED

QMS

Certified to

ISO 9001

- Certification: Feb 2001 - renewed (Oct 2012)
- Certified by KFQ [Korea Foundation for Quality]
- QMS of KRISS ***Complied with***;
  - ISO 9001: 2008 (for QMS)
  - ISO/IEC 17025: 2005 (for Calibration/Test)
  - ISO Guide 34: 2000 (for Reference Materials)
- ***Scope of Certification;***
  - Dissemination of standards: calibration, testing, RM;
  - Research and development activities
  - Administration and technical support activities


CERTIFICATE

QUALITY MANAGEMENT SYSTEM

kfq Korean Foundation for Quality

KOREA RESEARCH INSTITUTE OF STANDARDS AND SCIENCE

1, Doryong-dong, Yuseong-gu, Daejeon, Korea

Korean Foundation for Quality certifies that The Quality Management System of the above organization has been audited and has complied with the requirements of the following standard

Standard

KS Q ISO 9001:2009 / ISO 9001:2008

Scope certification

RESEARCH AND DEVELOPMENT, DISSEMINATION SERVICES OF STANDARDS

Technical Capability

Recognized by

Peer Reviews

1st round: 2001-2002

2nd round: 2006-2007

3rd round: 2012-2013

KC	CMC	Remarks
373	1139	Oct 2014,KCDB

FOR QMS-CIPM MRA: HONORED

Global System Grand Prix Award 2009

- QMS of KRISS recognized in Korea.
- Organized by the New Quality Forum;
- Sponsored by The Korea Economic Daily.