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Upgrading the National Quality Infrastructure

in the Republic of Armenia

April 15, 2011

The World Bank

with the support of Physikalisch-Technische Bundesanstalt

Abbreviations

AA	Accreditation Agency of the Republic of Armenia
AC	air-conditioning (unit)
BIPM	Bureau International des Poids et Mesures
CAB	Conformity Assessment Body
CEN	European Committee for Standardization
CENELEC	European Committee for Electrotechnical Standardization
CIPM	Comité International de Poids et Mesures
COOMET	Euro-Asian Cooperation of National Metrological Institutes
COPANT	Comisión Panamericana de Normas Técnicas, or Pan-American Standards Commission
DCFTA	deep and comprehensive free trade agreement (with the European Union)
DSME	Daewoo Shipbuilding and Marine Engineering Corporation
EA	European Cooperation for Accreditation
EASC	EuroAsian Insterstate Council for Standardization
EASC	Euroasian Interstate Council
EU	European Union
GCL	Global Certification Limited
GDP	gross domestic product
GNP	gross national product
GOST	gosudarstvennyy standart, or state standard
HACCP	Hazard Analysis and Critical Control Point
IAF	International Accreditation Forum
IEC	International Electrotechnical Commission
ILAC	International Laboratory Accreditation Cooperation
INDECOPI	Instituto Nacional de Defensa de la Competencia y de la Protección de la Propiedad Intelectual, or National Institute for the Defense of Competition and the Protection of the Intellectual Property, Lima (Peru)
INOGATE	Interstate Oil and Gas Transportation to Europe
ISO	International Organization for Standardization
IT	information technology

KOLAS	Korea Laboratory Accreditation Scheme
KRISS	Korea Research Institute of Standards and Science
MoE	Ministry of Economy
MRA	mutual recognition agreement
MSTQ	metrology, standardization, testing, and quality assurance
NAB	national accreditation body
NGO	nongovernmental organization
NIM	National Institute of Metrology of Armenia
NIS	National Institute of Standards of Armenia
NIST	U.S. National Institute of Standards and Technology
NMI	national metrology institute
NQI	national quality infrastructure
OHSAS	Occupational Health and Safety Assessment Series
OIML	International Organization of Legal Metrology
PCR	Protection of Consumers' Rights (Armenia)
QI	quality infrastructure
QM	quality management
QMS	quality management system
SARM	Standards of Armenia
SI	Système International d'unités, or International System of Units
TBT	technical barriers to trade
TR	technical regulation
WELMEC	European Cooperation in Legal Metrology

Executive Summary

An effective and internationally harmonized national quality infrastructure can contribute to Armenia's global competitiveness by improving the quality and safety of domestic products and services and by supporting the country's greater trade integration with the European Union (EU) through lower technical barriers to trade. Compared with other small countries (Bulgaria, the Netherlands, and Georgia), Armenia's proportion of trade in GDP is very low. Armenia has yet to exploit the full potential of the international division of labor. Moreover, most of its exports are concentrated in industries that compete on price and in low-quality market segments. As a landlocked country, Armenia is subject to transportation cost disadvantages that can be compensated for only by moving to higher-value products and services.

Some of the more sophisticated imports that Armenia exports to the CIS (e.g. pharmaceuticals and chemical products) do not yet occupy a prominent position among exports to the EU. Many of the products exported to the EU are unprocessed goods. Armenia can improve its trade competiveness with higher value-added products with the EU by ensuring that it meets the quality and standards of those markets. It can meet its societal needs and stimulate the tourism industry by ensuring that it has the infrastructure to implement environmental production, health, safety and food standards.

The term *national quality infrastructure* (NQI) denotes the complete public and private infrastructure required to establish and implement the standardization, metrology, inspection, testing, certification, and accreditation services needed to prove that products and services meet defined requirements, whether demanded by the government, society or the private sector.

This report outlines the World Bank's main findings on Armenia's NQI, collected during visits to the various public and private NQI institutions and detailed information gathered through visits of 46 enterprises –mostly SMEs - likely to have a need for NQI services and 24 laboratories, undertaken between October 2009 and February 2010. The study identifies several institutional and legal reforms required to harmonize Armenia's NQI with EU norms. It identifies gaps in the technical capacity of the NQI to meet the requirements of the EU free trade agreement and to support export competitiveness. It defines current and future needs for NQI services. And it provides recommendations for policy and investment priorities. The conclusions and recommendations of the final report can serve as a basis for the elaboration of a strategy for the development of a demand-led basic quality infrastructure in Armenia.

The study was supported by the German National Metrology Institute, Physikalisch-Technische Bundesanstalt, and conducted in coordination with the EU Advisory Group and the Armenian-European Policy and Legal Advice Centre.

Enterprises show major deficiencies in the adoption of modern quality practices.

A targeted survey of enterprises showed that quality improvement and quality assurance are not seen as crucial drivers of competitiveness. Although most firms report having implemented quality management systems (QMSs), less than half are actually certified to international management system standards such as those of the International Organization for Standardization (ISO)—for example, ISO 9001 or ISO 14000. Moreover, the limited knowledge of the employees of surveyed firms about QMSs raises questions about the degree of QMS implementation in firms.

A weak market for quality-related services such as certification, testing, and calibration poses challenges to product quality in Armenia.

A survey of laboratories shows that their personnel have limited knowledge of modern measurement methods and uncertainty of measurement, as well as of the application of QMSs according to the relevant ISO standards and guides. Personnel also lack training in the use of new equipment. In many cases, conditions in the laboratories (such as temperature, humidity, and power supply) are not conducive to meaningful laboratory results. The measurement results of the testing laboratories are doubtful because there is no documentation on their traceability to national measurement standards. One-third of laboratories in the survey had never participated in measurement intercomparisons. Only a quarter were accredited.

Enterprises surveyed point to a shortage of private certification bodies and testing laboratories. Armenia's national standardization body, the National Institute of Standards of Armenia (NIS), is still (incorrectly) considered to be the national certification body, and competition in this market is limited. An important limiting factor for the market's development is that, according to the national legislation, product certification bodies need to have their own testing laboratories. Such legislation does not exist in the EU or in Organisation for Economic Co-operation and Development (OECD) countries, where the market for independent laboratories is thriving.[1]

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[1] Although this is not forbidden or counterproductive, assuming that sufficient measures are taken to separate the different responsibilities and decision making process.

Many shortcomings in quality practices in enterprises and in quality-related services can be traced to deficiencies among public NQI institutions.

Several gaps can be directly traced to deficiencies in the national standardization, accreditation, and metrology systems:

- Exporting enterprises are faced with a parallel system of standards. Exporters need to comply with GOST (which stands for gosudarstvennyy standart, or state standard, and refers to a set of standards maintained by the EuroAsian Interstate Council for Standardization, Metrology, and Certification) for the domestic market, the Russian market, and other markets that are part of the Commonwealth of Independent States. They also must comply with ISO and International Electrotechnical Commission (IEC) standards in many export markets.[2] These parallel requirements increase production costs without giving exporters a real voice in the national standards development process. They also provide disincentives for non-exporters to export.

- No real industrial calibration system is in place in Armenia. Measurement equipment in industrial production processes and in both in-house and commercial laboratories either is only "verified" by the National Institute of Metrology of Armenia (NIM), which does not have the capacity to calibrate it, or needs to be calibrated by equipment suppliers. Although verification can give a "yes" or "no" for consumer protection purposes, it does little to improve product quality. Moreover, enterprises and laboratories display limited knowledge of the difference between the concepts of verification and calibration.

- Armenian certificates are not recognized abroad, including in the Russian Federation. This lack of recognition is one of the main obstacles for Armenian companies wishing to export and is directly linked to the limited presence of internationally accredited certification bodies in Armenia, the lack of international recognition of the national accreditation system, and the lack of international traceability in the national metrology system. Among the surveyed enterprises, the evaluation of NQI services varied from "very good" to "incompetent and corrupt," but the majority of survey respondents expressed dissatisfaction with the NQI system.

The current legislative and institutional framework is largely inconsistent with international best practices and leads to an ineffective NQI.

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[2] Although the most recent GOST standards, especially recent GOST R standards, are identical or equivalent adoptions of ISO or IEC standards, thousands of old GOST standards are not identical. Old translations of ISO and IEC standards very often do not reflect the standards' real content.

Current NQI laws do not reflect the norms, guides, and recommendations of international organizations such as ISO, IEC, the International Organization of Legal Metrology (OIML), the International Laboratory Accreditation Cooperation (ILAC), and the International Accreditation Forum (IAF). Moreover, the mandatory character of certain national standards differs from accepted international practices, where in principle all documentary standards[3] are voluntary, although in some cases they may be referred to in technical regulations y a regulatory body other than the national standards body. In OECD and EU countries, and in line with WTO TBT principles, technical regulations are used for purposes of safety, security, health and environmental protection, while standards have a much broader range of functions.

The existing system of elaboration and implementation of technical regulations has a number of gaps. In accordance with international practices, the elaboration of technical regulations is delegated to relevant line ministries, while the Ministry of Economy (MoE) coordinates and supervises this work. Unfortunately, officials in the line ministries do not have the relevant experience and are not trained in the elaboration of technical regulations. Although technical regulations are somewhat based on EU directives, key stakeholders state that they are not followed 100 percent because of lack of technical capacity. The requirements contained in the EU directives are often graded by means of different levels of strictness.

Although some progress was made in restructuring the NQI in the past few years, reforms remain largely incomplete. On the positive side, the old Gosstandart institution was transformed into four NQI institutions: (a) NIS, (b) NIM, (c) the Accreditation Agency of the Republic of Armenia (AA), and (d) the State Inspectorate for Market Surveillance and Consumer Rights Protection. However, in all cases, important gaps remain. The institutions still do not have the level of independence required to function effectively, particularly in the case of the accreditation body. Furthermore, decisions are not transparent; the institutions are not impartial and are subject to conflicts of interests. Finally, the private stakeholders of the NQI (enterprises, business organizations, laboratories, consumer and environmental protection nongovernmental organizations, and the scientific community) do not participate in the governance of the NQI institutions, except those that participate in the Accreditation Council.

The coordination of the Armenian NQI faces several challenges. On the positive side, the horizontal responsibility for the development of the NQI lies with the MoE. However, two deputy ministers and two divisions are responsible for NQI policy, which can produce

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[3] These are to be distinguished from measurement standards

unnecessary conflicts and problems.[4] Coordination with the relevant line ministries (the Ministries of Agriculture, Health, Energy, Environmental Protection, Urban Development, Emergency, and Justice) is also lacking and not clearly regulated.

Inspection and legal metrology are particularly ambiguous areas. The roles, responsibilities, and technical capabilities of the various agencies involved in these areas are unclear. The State Inspectorate for Market Surveillance and Consumer Rights Protection is involved in a mix of legal metrology, inspection, and some aspects of market surveillance. Because of its limited technical capacity, the inspectorate is active in only high-risk areas and products.

NIM acts as an instrument of state control rather than an institution that supports industrial competitiveness.

A country's scientific and applied metrology system ensures the maintenance and development of the national measurement standards and their traceability to the International System of Units (Système International d'unités, or SI). A country's industrial metrology system provides internationally recognized calibration services to producers and testing laboratories to ensure that measurements are reliable and of known uncertainty. Neither scientific and applied metrology nor industrial metrology exist in Armenia because the national measurement standards held by NIM are not traceable to the SI and are not disseminated to industry. As a result—and because of inadequate existing legislation—NIM acts mainly as a state control agency that verifies measurement instruments and does not provided value-added services to industry. Moreover, because of the lack of measurement traceability, NIM is only partially successful at verification. NIM's limited technical capacity is due to both its personnel, who are of an advanced age and are not trained for the application of modern calibration methods, and its equipment, which is mostly obsolete. Environmental conditions in NIM laboratories and on the entire NIM premises are not adequate for calibration laboratories.

NIS is subject to conflicts of interest and does not develop standards that reflect the economy's needs.

In Armenia, standardization is not an open and transparent process. Industry and consumers are underrepresented in the standardization process. The six existing technical committees are not very active, and very little of what NIS is doing in standardization reflects stakeholders' needs and interests. There is also a lack of awareness and engagement among private stakeholders. Standardization activities are not demand driven or service oriented.

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[4]Meanwhile, all NQI responsibilities are concentrated in a newly created division.

Even the staff of the Training Center has little practical knowledge of international NQI issues. The disconnection between NIS and the needs of the economy is reflected in the composition of Armenia's 20,000 standards. The large majority are GOST standards, which are mostly technologically obsolete and incompatible with ISO and IEC standards. One-quarter are "technical specifications," or standards produced by individual firms, and should not be part of the national standards collection. Given NIS's limited standardization activities, it is unclear why more than 50 people are employed in standardization, including administrative and technical staff members. NIS's certification activities produce an important conflict of interest that has to be abolished, as NIS both develops standards and provides services to implement them.

The services provided by AA are not recognized by the local or international market as technically credible or impartial and, as a consequence, does not serve the needs of the economy.

AA's structure and operational procedures are not in line with international practices. Accreditation decisions are not politically independent; AA is part of the MoE and accreditations are signed by the minister of economy. There is no separation between the board that develops the accreditation policy and the technical board that makes accreditation decisions. Many of these challenges arise not only from the legal and institutional framework but also from the very limited technical competence of AA's staff. Few staff members have been trained in international (ISO and IEC) standards and the recommendations of the main international accreditation organizations (ILAC and IAF), and almost none speaks English, which is essential for understanding international requirements and receiving appropriate training abroad.

The scope of accreditation is limited in Armenia. It includes only testing laboratories and product and QMS certification bodies. Inspections and certification bodies for persons are not accredited, and the law does not provide for accrediting calibration laboratories as is the case in other countries.

As a result of these gaps, the supply market for conformity assessment services in Armenia is unreliable, and domestic certificates, test results, and measurements are not recognized abroad. This obstacle to quality improvement imposes additional costs for retesting and recertification in importing countries.

Armenia must reform its NQI to meet the needs of its economy and the requirements of a prospective deep and comprehensive free trade agreement (DCFTA) with the EU.

Armenia can move forward on reform most effectively by creating an NQI Council in which the most important public and private stakeholders are represented. These would include, for example the NQI institutions, ministries that rely on the NQI, representatives of industry and representatives of conformity assessment bodies. The NQI Council will develop and discuss the strategic policy proposals and monitor the implementation of the necessary changes. Such a council could be established at the president's or prime minister's office. The executive function can be delegated to the Minister of Economy. A strategic plan should cover a period of 8 to 10 years and should aim for the development of an internationally recognized NQI.

National laws should be reformulated to conform to international best practices. The government can either enact a general quality law that includes the most important aspects of the NQI; specific laws (covering measurement, conformity assessment, standardization, and so forth); or a combination of specific laws (However, a single general law may be more difficult to continuously amend). The more specific technical issues should be formulated in amendments, decrees, and secondary legislation.

The institutional landscape of the NQI should be restructured to ensure political independence, transparency, and impartiality. Such restructuring would particularly apply to the existing four main bodies—NIM, NIS, AA, and the State Inspectorate for Market Surveillance and Consumer Rights Protection (which has to be transformed into a market surveillance institution)—but it would also apply to the certification bodies and the technical inspection bodies. The main stakeholders (the government, enterprises, laboratories, consumers, and the scientific community) should participate in the decision-making process of the NQI, specifically in governing, advisory, or trustee bodies of NIM, NIS, and AA. Mandatory and voluntary standards and procedures will need to be clearly defined in agreement with international rules developed under the World Trade Organization and—in the case of the DCFTA—by the European Commission.

In the short term, Armenia's NQI will be able to cover only the country's most basic needs. In some cases (for instance, research and development, food safety, and health), cooperation with foreign NQI bodies will be indispensable. Nonetheless, it is unlikely not in Armenia's best economic interest to adopt *all* EU and international standards and technical regulations immediately.

A new national metrology institute should be created and seek international recognition in priority fields of measurement.

A new national metrology institute of limited size (roughly 25 to 30 staff members) should be established to develop scientific and applied metrology in Armenia. Its aim should be to secure traceability to the SI and to disseminate the units to industry and society. The existing agency, NIM, could focus on legal metrology and provide certain services to industry during the establishment of the new national metrology institute. In the future, the management and staff of the two institutions should be clearly separated.

The new national metrology institute's structure should be harmonized with international best practices. A consultative board should include stakeholders (the public and private sectors, the scientific community, laboratories, and consumer and environmental protection nongovernmental organizations), and a marketing and financing program (business plan) should be developed.

National measurement standards should have traceability to internationally recognized national metrology institutes—and hence to the SI—through an unbroken chain of measurement comparisons (that is, calibrations). Such traceability will require active cooperation with other national metrology institutes and relevant regional metrology organizations, such as the Euro-Asian Cooperation of National Metrological Institutes (COOMET).

To serve its national needs, Armenia should prioritize development of the following metrological laboratories:

- Mass and weighing instruments
- Pressure (and force)
- Temperature
- Electricity
- Flow
- Metrology in chemistry (selected areas in physicochemistry, such as pH and electrolytic conductivity, and in analytical chemistry, such as metals in food as part of food safety)

Developing these laboratories will require purchasing up-to-date measurement standards and equipment, training employees, and ensuring traceability to the SI. Starting with a single pilot laboratory is recommended. Laboratory staff members will require training in the relevant standards and measurement methods and in implementing a management system that meets international requirements (ISO/IEC 17025). Staff members should have good

knowledge of English. Government commitment and continued financial support by the government are essential.

Given the poor state of NIM's existing facilities, the development and modernization of metrological laboratories will require either a new building or major retrofitting of existing facilities (that is, installation of air-conditioning systems, floor construction, and so forth). Both approaches are expensive. In the area of chemical measurements, Armenia should consider the feasibility of designating other laboratories that have already acquired these competencies.

Achieving international recognition of the national metrology institute's laboratories will require the following steps over a period of 4 to 8 years:

- Successful participation in regional and international intercomparison measurements (organized by the regional metrology organization COOMET) to register so-called calibration and measurement capabilities in the International Bureau of Weights and Measures (BIPM) Key Comparison Database.

- Accreditation of selected laboratories by an internationally recognized accreditation body or by self-declaration (peer review).

- Signing of the International Committee of Weights and Measures (CIPM) Mutual Recognition Arrangement (MRA). A prerequisite for this is that the country has signed up as a Member State to the inter-governmental treaty of the "Metre Convention" or has become an Associate State to the General Conference of Weights and Measures CGPM; in both cases the government needs to make an official decision.

NIS should be restructured and downsized, and its governance and management should be revised to reflect international norms.

NIS should be the national standards body in legal and practical terms. It should be governed by a superior body with a balanced representation of the major private and public stakeholders. The principle of balanced representation should be introduced to technical bodies as well. There should be no ambiguity that all standards are voluntary.

Two options are available to eliminate conflicts of interest: (a) to fully and immediately separate the standardization and certification divisions of NIS or (b) to keep them in a single institution in the medium term but to strictly separate the management and decision-making process of the two divisions and build firewalls between the two. In both cases, a business plan or a marketing and financing concept should be developed. Keeping a strict separation in option (b) can be expected to be difficult to implement. Option (a) will be more effective.

NIS standardization activities should be more demand driven. As a start, the standardization staff should be reduced to approximately 20 people. Technical committees should reflect stakeholder needs and expectations and should mirror technical committees in regional and international organizations. The registration of "Technical Specifications," a relic of Soviet times, should be gradually abandoned.

NIS technical officers should receive training to fulfill their functions as project and process managers so that they can facilitate the technical process and provide guidance to stakeholders concerning the rules to be observed, process national standards, coordinate Armenia's position in international bodies, and manage the data and information flow among the different levels and stakeholder groups.

The Training Center's capacity should be strengthened by instructing national trainers on international good practices in standardization (including good regulatory practice) so that the center can become a sustainable engine of the modernization and approximation process.

NIS should be more active in ISO and seek some form of membership in the EU's regional standards body, the European Committee for Standardization. Membership in IEC and the European Committee for Electrotechnical Standardization is also desirable.

The immediate establishment of a new independent national accreditation body will be required to achieve international mutual recognition in the medium term.

The government must first decide whether to implement its own small national accreditation body (with a staff of five to seven), whether to allow foreign accreditation bodies to provide services in the country (also determining in which areas and to what extent), or whether to do both. This decision must take into account the high costs of maintaining a national accreditation body. When the market for accreditation is not yet developed, particularly in small, emerging economies, accreditation cannot be self-financed, and state support is necessary.

The accreditation process needs to be conducted under the principles of political independence, transparency, impartiality, and confidence. Hence, the national accreditation body needs to be independent from policy-making bodies such as the MoE. It could be a public-private partnership established as a private nonprofit body or an independent public body. All main public and private stakeholders should be included in the Accreditation

Council. The accreditation process should comply with international standards such as ISO/IEC 17011:2004.

Once established, the national accreditation body should develop accreditation processes in all fields, one at a time: calibration and testing laboratories, product and QMS certification bodies, inspection bodies, and certification bodies for persons.

Persons who know, understand, and apply international standards must perform the evaluation and decision-making process. Training in accreditation means, preferably, learning by doing (through lectures, practical application, coaching, and so forth) and requires international experts with practical experience in applying the ISO standards and ILAC and IAF guides. The national accreditation body will need to develop a broad pool of specialists. In some cases, hiring foreign experts will be necessary.

The national accreditation body should establish a close and permanent relationship with the relevant international and regional accreditation organizations, including the European Cooperation for Accreditation (EA), ILAC, IAF, and perhaps the Asia Pacific Laboratory Accreditation Cooperation. A cooperation contract with EA could help the national body acquire the necessary technical information and assistance to develop the accreditation system.

International recognition through a mutual recognition agreement with ILAC and IAF could be achieved within approximately six years.

The government should clarify the organization of the technical regulations and the consumer protection and market surveillance system and ensure their compatibility with international and European norms.

A first step will be to educate and inform all interested parties about concepts, status, objectives, similarities, and differences between technical regulations and standards, as well as with the GOST system of mandatory standards. This step will entail not only awareness-raising campaigns but also training of line ministry officials on the elaboration of technical regulations. The establishment of interdisciplinary and interministerial working groups for the elaboration and implementation of priority technical regulations should be promoted. Market inspectors will require training in international and EU surveillance methodology and practices.

Achieving some level of harmonization with the EU will require the equivalent or identical adoption of priority European directives. The adoption of New Approach Directives requires the full and largely unchanged adoption and national implementation of the relevant harmonized European standards and conformity assessment procedures. Only directives for which there is a realistic prospect of technical capacity for enforcement in the country should be adopted. Conformity assessment costs should be weighed with benefits.

Finally, an effective regulatory system will require defining and clearly distinguishing between the tasks of legal metrology, technical and other inspections, and market surveillances and assigning these tasks to specific institutions.

Improving quality and consumer protection in Armenia will entail strengthening the capacity of the country's network of testing and calibration laboratories, as well as its certification bodies.

The government should take active steps to raise awareness of the instruments, methods, and procedures (including QMSs) required for reliable and credible testing results. For this reason (a) an awareness-raising campaign should also be targeted to laboratories; (b) representatives of the laboratories should participate in the NQI council and in the boards of the national metrology, standardization, and accreditation institutes; and (c) the government should promote the establishment of laboratory associations and their linkage to the relevant international organizations. The government should explore opportunities for attracting foreign investors in the area of conformity assessment. Moreover, the government should remove the requirement for certification bodies to have their own testing laboratories.

The government should invest in improving the environmental conditions in laboratories to secure stable and reliable measurement and testing results, the technical capacity of laboratory personnel, and the implementation of a quality system in the laboratories. This investment could be done on a match-funding basis in private laboratories. It could also be accomplished through targeted subsidies to public laboratories if there is no scope for private investment because of limited market size but a strong rationale for public support exists (as would be the case in areas such as health and the environment, where social externalities are high). Any investments in upgrading public laboratories or in creating new laboratories should be the result of proper market demand assessments.

The government will need to provide continuous budgetary support for several quality infrastructure organizations in the foreseeable future, but the rest can be supported by the market.

The government will need to provide ongoing budgetary resources to cover the initial and continued modernization and updating of the national measurement standards and, in the short to medium term, some of the operational costs of the national standards, accreditation, and metrology bodies. In the short run, costs for a new metrology institute could range from USD 4-6 million for a new building; USD 4-6 million for new equipment; USD 1 million for IT equipment, information systems and databases; tens of thousands to hundreds of thousands of USD for memberships in the main international NQI organizations; training and consultancy costs for all NQI institutions could range in the hundreds of thousands of USD annually for the first few years. Other costs will include expert contributions for institutional policies, new legislation and awareness raising. Certification, testing, and lower-level calibration should be left to the market in the medium to long run. The government should gradually disengage from those services.

Armenia can also exploit economies of scale and reduce costs in the development of its quality infrastructure by coordinating on the development of technical capabilities such as laboratories and training, with neighboring countries. Armenia can specialize on capabilities that are not available in other countries and vice-versa.

Increasing the diffusion of quality and standards in Armenia will also require stimulating the demand side of the market.

Most firms in Armenia are not aware of modern testing, calibration, and quality management methods and will not automatically seek the services of a newly reformed and upgraded quality infrastructure. Increasing demand will require awareness-raising campaigns for industry, training programs on modern methods, and competitive match-funding programs for implementing standards or preparing for certification. Other improvements to the business environment, such as competition policy, will also be required to provide market incentives for quality upgrading.

To summarize, there are several immediate opportunities for implementing low-cost measures that can yield benefits to the economy:
- Creating an NQI Council

- Restructuring the NQI by:

- o Creating a new basic independent accreditation body

- o Creating a new national metrology institute

- o Downsizing the national standards body and clearly separating standardization from conformity assessment.

- Removing mandatory requirements and technical specifications in conformance with international guidelines.

- Aligning the NQI legislation with international requirements.

- Clarifying the organization of the technical regulations, consumer protection and market surveillance system.

- Remove national legislation requiring product certification bodies to have their own testing laboratories.

Armenia can also start investing now in capabilities that will take at least 5 years to gradually build:
- Developing the technical capacity of the new national metrology institute and seeking international measurement traceability.

- Building staff and organizational capacity in all NQI institutions.

- Seeking membership in international NQI organizations.

- Raising awareness for NQI needs in the private sector.

- Building technical capacity for quality upgrading and quality services in the private sector.

- Developing new accreditation scopes or attracting a foreign accreditation body for certain scopes and recognition, including acceptance of calibration certificates.

- Seeking multilateral recognition in the area of accreditation.

1. Introduction

1.1. The Quality Infrastructure in a Globalized World

Measurements, standards, and testing are important elements to ensure the quality of industrial products. They constitute a technical base for trade of commodities and goods and for protection of consumers, health, and the environment. Producers and consumers use the components of quality infrastructure (QI) without being conscious of it.

In a globalized world, QI components are gaining importance for many reasons:
- Trade in commodities is global.
- Food products may originate from anywhere.
- The spread of diseases is global.
- Environmental and climate issues are global.

A well-organized and reliable QI is a precondition for the functioning of international trade. Moreover, environmental protection, health services, and food safety require standards, measurements, and reliable tests. Standards support compatibility and diminish costs by enabling equivalent parts, specifications, and methods; they are important for the creation of new industries and use of new technologies; and they are decisive for access to new markets.

In recent decades, the concept of quality has gained much importance. Consumers require higher levels of security, reliability, and sustainability, as well as better functionality of products and services. Because of globalization, parts of products (for instance, cars) are being produced all over the world; these parts are then assembled to create the final product. All this work requires standardization; a high level of measurement and testing; and a network that provides reliability, comparability, and confidence.

This rising network has national, regional, and global dimensions and comprises many public and private actors, who work together, both directly and indirectly. Not only does a well-developed country need a physical infrastructure, including roads, energy production and transmission, and basic services such as education and health for its evolution; it also needs a network of institutions ensuring the quality of products and services and a minimum of quality of life. Hence, in recent years, the term *quality infrastructure* has grown in use. The notion of QI underlines that each country needs a basic framework of such institutions, which must be correlated with regional and international networks if economic and social

development is to be sustainable. Most states consider it their role to enable the access of citizens to these institutions. Some parts of the QI clearly constitute a public good (for instance, the custody and maintenance of the national measurement standards as a part of the metrology).

The term *quality infrastructure*[5] can be defined as the totality of the institutional network—whether public or private—and the legal framework that (a) is formulating, editing, and implementing standards (that is, establishing rules for common and repeated use directed to obtain an optimal order in a given context considering current and potential problems) and (b) gives evidence of fulfillment of technical requirements (that is, through a relevant mixture of inspections, tests, certification, metrology, and accreditation) with an aim to improve the adequacy of products, processes, and services for desired purposes; to impede commercial barriers; and to facilitate technical cooperation.

In the last decades of the 20th century, the services necessary for satisfying this demand have formed a QI that comprises many elements (see figure II.1). The most important follow:

☐ **Standards and technical regulations:** The formalized documentation that determines the requirements that a product, process, or service must accomplish. Essentially, standards are considered voluntary. They become obligatory only if they are agreed to in a conformity contract. If the state transforms them into technical regulations for public security or health reasons, they will also become mandatory.

☐ **Metrology:** The technology and science of measurement. Usually, metrology is divided into three types:
  ▪ *Scientific and applied metrology*, which describes and disseminates the measurement units
  ▪ *Industrial metrology*, which by calibrations guarantees the adequate working of measurement instruments that are used in production and tests
  ▪ *Legal metrology*, which secures by law the accuracy of the measurements in cases that have an influence on the transparency of economic transactions, on health, and on security.

☐ **Testing:** Evaluation that determines the characteristics of a product in comparison with the requirements of a documentary standard.[6] Testing can vary from a simple visual eval-

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[5] Earlier publications often used the term *MSTQ* (which stood for metrology, standardization, testing, and quality assurance). The term *QI* is broader and especially emphasizes the networking between different actors. The term also covers new aspects and appearances.
[6] As distinguished from measurement standards

uation; to a nondestructive evaluation (for instance, x-rays or pressure tests, after which the products can be used); to a totally destructive analysis (for instance, chemical, mechanical, physical, or metallurgical tests, after which the products cannot be used); or any combination thereof.

☐ *Certification:* The formal verification that a product, a service, an organization's management system, or the competence of a person corresponds to the requirements of a documentary standard.

☐ *Inspections:* Activities contracted by private clients, organizations, or state authorities that examine the design of products, services, procedures, or installations and evaluate their conformity or nonconformity against general or specific requirements that exist in laws, technical regulations, standards, and specifications.

☐ *Accreditation:* An independent confirmation of the management and technical competence of an individual or organization to deliver specific services (that is, calibrations, tests, certifications, and inspections).

All these elements are interrelated and are intended to give—up to a certain point—the appropriate confidence to the buyer, user, or authorities that a product, process, or service conforms to expectations.

A QI is a network of many elements (figure II.1) that are important to different aspects of economic, social, and scientific development. It is a system with a large number of actors, stakeholders, and interested parties:
- The government and its regulatory agencies
- The micro, small, medium, and large enterprises that produce goods, as well as their organizations (chambers of commerce and business associations)
- Calibration, testing, and clinical laboratories
- Consumers represented by consumer protection nongovernmental organizations (NGOs)
- Environmental protection NGOs
- Academic institutions
- Institutions of investigation, development, and innovation.

The QI network is very complex and dynamic and has many public and private stakeholders. Main efforts in recent years consisted of establishing rules to make the system transparent, comparable, and reliable and to build stakeholder confidence. The main instruments used

have been the standards and guides of the International Organization for Standardization and International Electrotechnical Commission and the mutual recognition agreements and multilateral recognition arrangements within the international organizations that secure the conditions for international recognition of measurement and testing results and results of inspections and certifications.

Figure II.1: **The National Quality Infrastructure and Its Relationship to the Value Chain and the Regional and International Quality Infrastructure**

Source: Physikalisch-Technische Bundesanstalt.
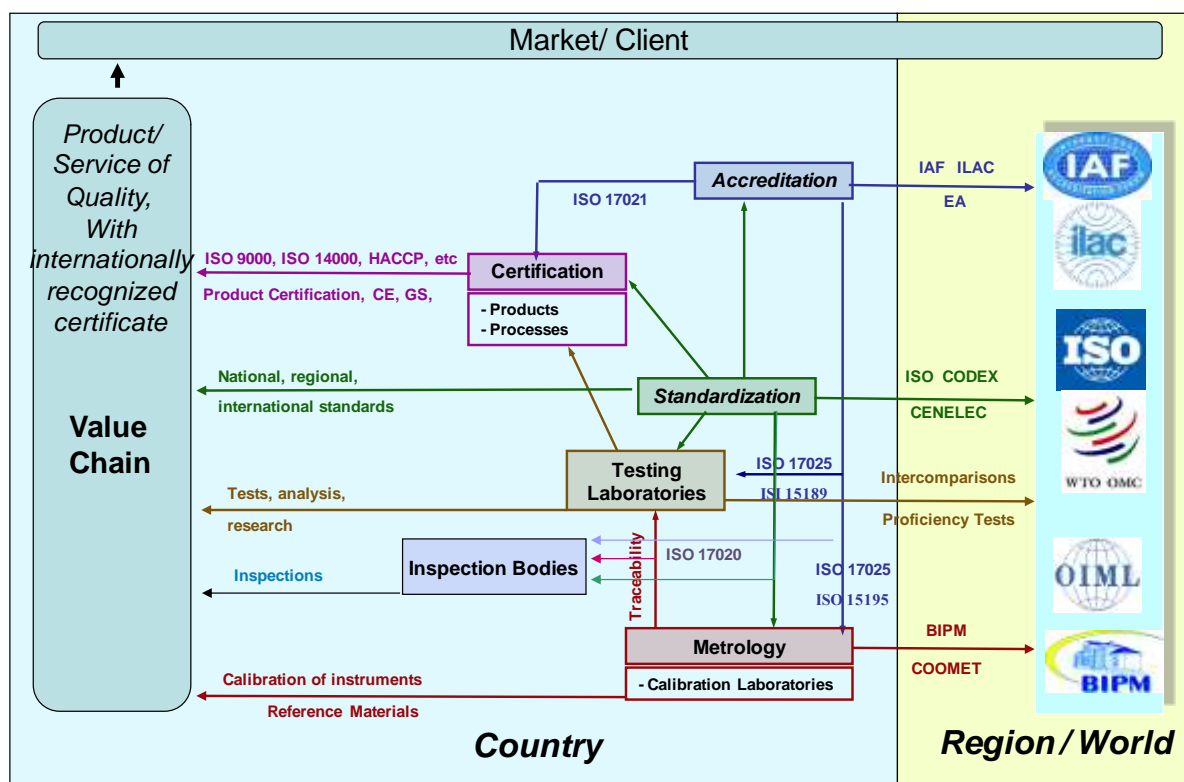
In the center of the QI are three basic institutions (see figure II.2). One is the national metrology institute (NMI). In most countries, the NMI is a public institute with its own state budget. If the private sector manages the NMI, the obligations of the NMI are normally fixed in a contract (for instance, custody and maintenance of the national measurement standards or representation of the country in international organizations); the state's obligations (financial means) are also fixed in the contract. In many countries, the second institution, the national institute of standards, is an entity of private law, but the state participates in its executive council. The third institution, the national accreditation body (NAB), is usually a private entity with state participation, and its activities are regulated by the legal framework of the QI. However, state bodies exist in a legal form that guarantees that the state cannot intervene in technical decisions. Public-private partnership within the NAB is important.

The three institutions can accomplish their tasks in accordance with international rules and best practices only if they fulfill the following principles:

- Clear, political management that is independent of the three institutions
- Transparency of activities and decisions
- Approved technical competence of the staffs of each institution
- Participation of the stakeholders in the development of the institutional policy

Figure II.2:   The Three Basic Institutions of a National Quality Infrastructure

National Metrology Institute (NMI)	National Standardization Body (NSB)	National Accreditation Body (NAB)
• Typically an institution of the Central Government under the jurisdiction of the Ministry of Economy or Trade (sometimes the Ministry of Science and Technology). • Secures the dissemination of the international system of units (SI) and the traceability of the measurements to the definitions of the SI. • Provides traceability to the laboratories of Legal Metrology, industry, research institutions. • Calibration is voluntary. Verification is obligatory.	• In some countries a private institution which is self-financed by the development and the dissemination of standards. They have technical committees in which all stakeholders interested in developing standards are represented. • The standards developed by the NIS have a voluntary character. • They can be referred to by technical regulations which are obligatory.	• This institution is independent of the others to secure the independence of its decisions about accreditation. • The NMI makes its technical experts available for the accreditation process. • Accreditation is voluntary.
MAIN PRINCIPLE: INDEPENDENCE OF THESE THREE BASIC ELEMENTS.		

Source: adapted from PTB presentations.
Note: SI = International System of Units.

1.2.   Armenia and the Deep and Comprehensive Free Trade Agreement

The World Trade Organization Agreement on Technical Barriers to Trade[7] is based on international standards. It provides a model for free trade agreements, or FTAs (figure II.3). For this reason, knowledge of it is fundamental. The agreement defines

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[7] The text of the agreement is available at
http://www.wto.org/english/docs_e/legal_e/legal_e.htm#agreements.

- Conformity assessment procedures
- Information and the technical assistance
- Standards and technical regulations
- Exchange of information

Its intention is to prevent technical regulations and standards from becoming commercial barriers. Therefore, all countries should establish points of information—known as *inquiry points*—on technical regulations and standards. Many countries have made their standards institutes inquiry points. In other countries, inquiry points are linked to the department of foreign trade in the ministry of foreign relations.

Figure II.3: Free Trade Agreements and Quality Infrastructure
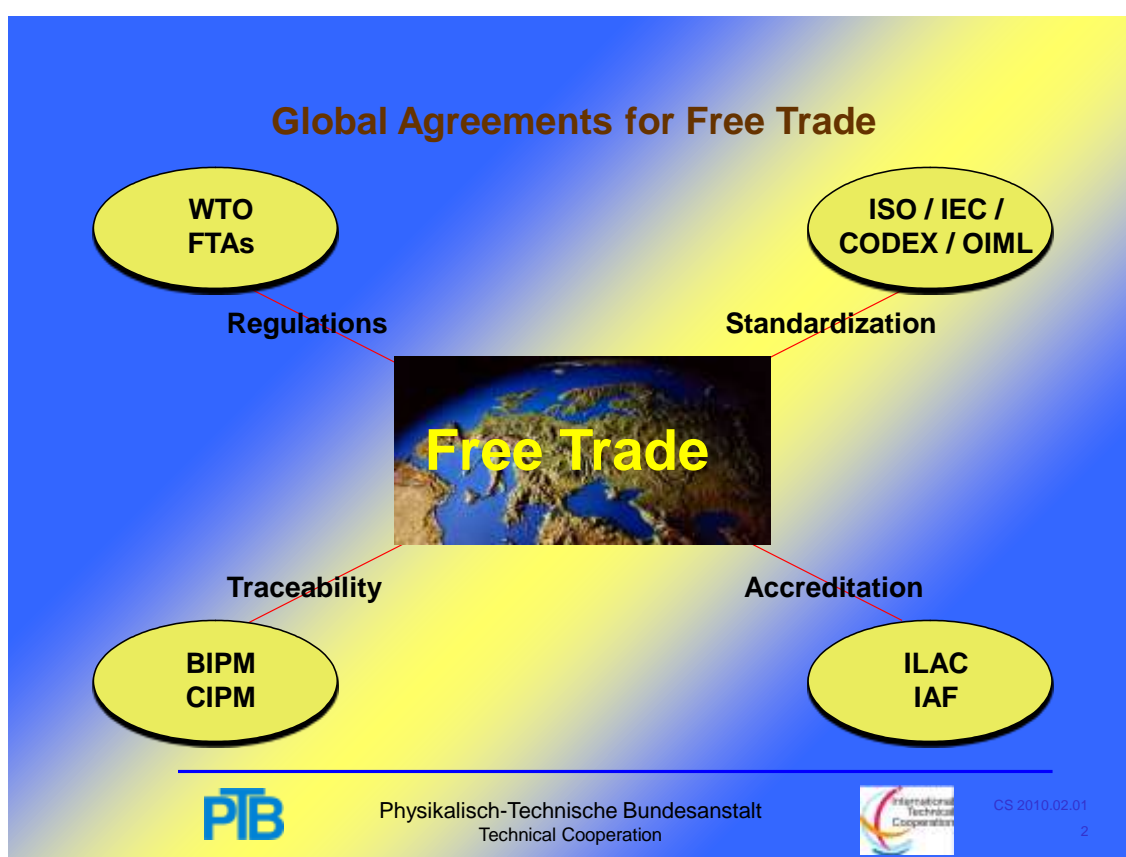
Source: Physikalisch-Technische Bundesanstalt.

There is a very close relationship between a country's QI and the FTA negotiations. Only a country that possesses a basic and internationally recognized QI can participate as a partner with equal rights and opportunities in commercial exchange.

In the case of a deep and comprehensive free trade agreement (DCFTA) negotiated with the European Union (EU)—which requires very intensive cooperation and strong proximity to the

EU—the requirements go much further. In a DCFTA, the objective is to facilitate equal and practically unrestricted commercial relations between the respective country and the EU for the specified goods. Far-reaching similarities must exist in the country's legal and institutional framework and the EU standards, and the country's framework is requested to operate in accordance with EU standards. Because the QI forms an indispensable base for a DCFTA, it must be adjusted to EU standards, directives, and best practices.

1.3. Methodology and Objectives of the Study

Objectives of the Needs Assessment Study

The overall objectives of this study is to support Armenia's global competitiveness by strengthening the quality and safety of domestic products and services and by achieving greater trade integration with the EU through decreased technical barriers to trade linked. The study

- Outlines outstanding institutional and legal reforms required to harmonize the national quality infrastructure (NQI) with EU norms
- Identifies gaps in the technical capacity of the NQI to meet the requirements of the EU DCFTA and to support export competitiveness
- Defines current and future needs for services of the NQI as a basis for the conformity assessment
- Provides recommendations for policy and investment priorities

The conclusions and recommendations of this final report serve as a basis for the elaboration of a strategy for the development of a demand-led basic NQI in Armenia.

Methodology of the Study

The study was undertaken in Armenia between October 2009 and February 2010. The current situation of the NQI was analyzed—namely, the public and private institutions involved in metrology, standardization, accreditation, certification, testing, technical regulations, and (to a lesser extent) inspections and market surveillance. At the same time, findings were considered in light of the defined export potential, the foreseeable economic development trends in Armenia, and the international development trends in QI.

The study was carried out in four steps (see figure II.4):

1. *Assessment of stakeholder demand:* This step included an inquiry of 46 companies and 24 laboratories (selected in accordance with the current economic structure and future export potential); a visit to the relevant ministries (the Ministries of Economy, Agriculture, Energy and Natural Resources, Environment, and Urban Development); and meetings with a consumer protection and business organizations.

2. *Assessments of gaps:* This step assessed the capacity of the four existing QI institutions to carry out their mandates in view of domestic needs and international requirements.

3. *Upgrading priorities and options:* Priorities and alternatives for the technical and institutional upgrading of the national QI institutions were elaborated with the aim of developing a demand-led basis that responds to domestic needs and international requirements over the next 5 to 10 years.

4. *Recommendations:* Detailed recommendations on institutional reforms, capacity building, and infrastructure investments were developed, taking into consideration the QI Roadmap agreed on by the Ministry of Economy in February 2010. Activities for international cooperation were proposed. In April 2010, the findings and recommendations were presented and discussed with representatives of the Armenian government, the most important NQI institutions, private stakeholders, and the international donor community.

The study was supported by Physikalisch-Technische Bundesanstalt (PTB) Braunschweig and Berlin and realized in coordination with the EU Advisory Group and the Armenian-European Policy and Legal Advice Centre (AEPLAC).

Figure II.4:   Approach of the Needs Assessment

1. Assessment of stakeholder demand

2. Assessment of the gaps in the national quality infrastructure

3. Priorities and options for institutional and technical strengthening and harmonization

Roadmap for the development of the quality infrastructure (supported by AEPLAC, EU Advisory Group and PTB)

4. Detailed recommendations for institutional reforms, capacity building, investments and international cooperation

2. Demand for Quality and Standards

Information on the use of quality and standards in enterprises, and of their relationship to the NQI, was gathered through a survey of enterprises. In all, 46 companies and 24 laboratories were visited. The objective was to select specifically those companies and laboratories that would have an immediate need for QI services. The surveyed entities reflected sectors that typically demand quality services in industrialized economies. Sectors were selected on the basis of information about the economic structure of the country, export data of previous years, and a first cautious prognosis about the export potential of the country (see chapter 6). Basic infrastructure services such as energy and water supply, railways, and clinical laboratories were included as well.

2.1.   Summary of the Demand Survey of the Companies

Methodology

For enterprises and testing laboratories, the following sectors were targeted in the survey:
- Food processing and beverages
- Mining and metal processing
- Jewelry
- Construction and construction materials
- Information technology (IT)
- Mechanical and electromechanical industry
- Pharmaceutical industry
- Cosmetics
- Public services (energy, water, and gas supply and transportation)

Questionnaires and checklists were used to collect the necessary information. The 46 companies visited reflected in a certain manner the industrial structure of the country (see table III.1).

Table III.1:   Companies Visited, by Branches

Sector	Number of companies interviewed	Share (%)
Food, food processing, and beverages	14	30.4
Cosmetic and stomatological products	3	6.5
Pharmaceutical products	1	2.2
Mining and metallurgy (gold and molybdenum)	4	8.7
Jewelry and gold goods	3	6.5
Construction and construction materials	4	8.7
Mechanical production (metal and plastic and metric equipment)	5	10.9
Electrical devices	1	2.2
IT and software	5	10.9
Textile industry	1	2.2
Furniture	1	2,2
Services (architectural design)	1	2.2
Public water supply	1	2.2
Energy supply	1	2.2
Gas supply	1	2.2

Source: Survey.

The sample included small, medium, and large enterprises, as defined by number of employees (see table III.2). The number of employees in the companies visited varied from 5 to 6,000 (Armgasprom). Including companies of each size ensured that the study's results would reflect the different needs of small, medium, and large enterprises.

Table III.2:   Staff Structure of the Companies Visited

Number of employees	Number of companies visited	Share (%)
1 to 20	11	26.2
21 to 50	9	21.4
51 to 200	11	26.2
201 to 500	4	9.5
More than 500	7	16.7
Total	42	100.0

Source: Survey.

Note: Of the 46 enterprises visited, 3 did not state the number of employees, and 1 uses only seasonal workers.

Most companies and laboratories participating in the survey were interviewed and visited directly on site. Several visits were made to companies with in-house laboratories. Most of those laboratories did not intend to seek accreditation. Such laboratories were exclusively used for in-process measurement and final inspection of products. For the purposes of the survey, they were classified as laboratories.

The focus of the questionnaire for companies was as follows:
– Scope and company information
– Products and sales information
– Quality management system and quality management staff
– In-house testing and calibration laboratory
– Equipment
– Perception of the National Institute of Metrology
– Standards and standardization
– Product certification
– Governmental inspections
– Membership in chambers of commerce and associations
– Perception of QI suppliers
– Obstacles or barriers to competitiveness

Degree of Qualification of the Companies' Staff

According to the interviewed companies, young professionals and specialists were lacking, for example, in furniture manufacturing and plastic and metal products manufacturing. Special training facilities for young professionals were in demand.

Products and Sales Information

The core products of the interviewed companies were energy meters, plastic containers, furniture, honey, natural gas, IT solutions, metallurgical products, services, construction and construction materials, drinking water, food (lavash), and cosmetics.

Out of 46 companies, 9 (20 percent) exclusively export their products, 20 (43 percent) produce both for the domestic market and for export, and 17 (37 percent) sell their products only on the domestic market (table III.3).

Exported products are as follows:
  − Molybdenum, iron-molybdenum, and rhenium
  − Juice, jams, and vegetables
  − Electronic measuring equipment (no manufacturing) and electric devices
  − Software and software solutions (automation software)
  − Universal milling machine tools
  − Jewelry and gold goods

Table III.3:   Sales and Export Data

Sales market	Number of enterprises	Share (%)
Only domestic market	17	37.0
Only export markets	9	19.5
Both	20	43.5
Export markets:		
Commonwealth of Independent States (CIS)	20	43.5
Russian Federation	16	34.8
Other CIS members	14	30.4
European Union	10	21.7
United States	15	32.6
Other countries[a]	9	19.6

Source: Survey.

a. These countries are mainly Georgia and the United Arab Emirates (especially Dubai) but also include the Republic of Korea.

Exported products are delivered mainly to the following countries or regions (see table III.3):

- Russian Federation—juices and jams, jewelry, textiles, milling machine tools, and mineral water
- Other members of the Commonwealth of Independent States (CIS)—measuring equipment, fish and fish products, and meat products
- European Union (EU)—iron-molybdenum and gold)
- United States—software, juices and jams, and jewelry

Although the official figures show that the participation of the CIS in Armenian exports is decreasing (from 81 percent in 1993 to 31 percent in 2009—see chapter 6), CIS member states (particularly Russia) still play a significant role, specifically in food and other manufactured products. New important export partners are the countries of the Middle East neighboring Georgia. Only 10 of the 46 surveyed companies exported to European countries, and only 15 exported to the United States, but 20 exported to CIS members.

This reality has an important influence on the quality requirements, which are principally divided in two sections. One is defined by World Trade Organization (WTO) rules. The other is determined by the EuroAsian Interstate Council (EASC) the interstate commission for

standardization, metrology, and certification for the CIS. In the case of the latter, the old GOST standards still dominate.

One may assume that the quality requirements for manufactured products in Armenia come from the domestic market and the CIS countries. Little pressure exists to produce in accordance with the international conformity assessment procedures and the standards defined by the International Organization for Standardization (ISO) and International Electrotechnical Commission (IEC).

Most companies find that even exporting to Russia and other members of the CIS is difficult. A second product certification process is necessary because the Armenian procedure is not recognized.

The lack of the recognition of Armenian certificates abroad, including in Russia, is an important obstacles to exports.

Quality Management System and Quality Management Staff

Of the surveyed companies, 33 stated that they had a quality management (QM) section and named a quality manager. The number of QM staff members involved in measurement varied widely, as high as 25 percent of the total staff.

Almost all companies stated that they conduct receipt inspection, in-process measurements, and final inspections. The degree of realization of these measures should be further analyzed.

Of the companies, 19 stated that they had a quality management system (QMS) that was implemented and certified according to ISO 9001. Three were certified by the National Institute of Standards of Armenia (NIS), eight by Global Certification Limited (box III.1), and one by the Swiss certification body SGS.

Box III.1: Global Certification Limited

Global Certification Limited (GCL), also trading as Global Group, is an international accredited certification body with offices in many major cities worldwide. GCL is accredited by the United Kingdom Accreditation Service, and its certificates are internationally recognized.
   Schemes include the following:
- ISO 9001
- ISO 22000
- ISO 14001
- Lift Regulations
- Pressure Equipment Regulations
- Hazardous Analysis and Critical Control Point (HACCP) principles
- Occupational Heals and Safety Assessment Series (OHSAS) 18001

Several companies answered the question about the certifying body in vague and doubtful terms (for instance, one company claimed to be certified by NIM). Some of the interview partners knew that the company was certified but not by which certification body. Also, in some cases the certification was expired but staff members were unaware of it and thought that certification was virtually indefinite. Thus, the degree of implementation of companies' QMSs is in question. Only in a few cases could companies provide a certificate to the interviewer.

Five of the companies intended to implement a QMS according to ISO 9001, and three were preparing to implement such a system. Two of the companies visited had an environmental management system that was certified according to ISO 14001. Six companies intended to implement an environmental management system. Only one company had HACCP certification.

Better measurement and system certification according to ISO 9001, ISO 14001, and HACCP principles are apparently not considered a milestone on the way to competitiveness and are not thought to facilitate the export of goods.

There is little awareness about the real advantages of an implemented QMS. Such advantages include efficient, monitored, and safe processes; cost savings; acceptance of products in the domestic and international markets; and increased competitiveness.

In-house Testing and Calibration Laboratory

Out of 42 companies, 15 claimed to operate an in-house testing and calibration laboratory. They are responsible for process control and assessment of product quality. Ten of these laboratories were visited. The companies did not foresee seeking accreditation for these laboratories.

The number of staff members working in in-house laboratories varied from 2 to 16. According to the survey, staff members of in-house laboratories were, as a rule, specialists such as food technologists, chemists, and microbiologists. However, there was a lack of special metrological qualification. Metrological qualification often predated 1991. The equipment of the visited in-house laboratories was mainly obsolete. Uncertainty of measurement is mostly an unknown concept.

Equipment

Comprehensive information on equipment used in the companies' processes is unavailable. The data is very fragmented and often incorrect. Most of the companies did not have an overview of their equipment or of its performance. They were unaware of the importance of measurement equipment and often did not know which equipment needed calibration and which did not. Only a very few were aware of the term *measurement uncertainty*, even though most of the interview partners stated that did they know the uncertainty of the equipment used. But because NIM verification certificates do not include measurement uncertainty, such statements are questionable. Few companies were developing and consciously improving their measurement equipment.

Ongoing changes in Armenia are an important factor of influence, following the breakdown of many manufacturing enterprises. Hence, it is only possible to emphasize that at the moment there is a basic need for calibration, verification, and other metrological services securing the traceability and reliability of the measurements.

Perception of the National Institute of Metrology

Of the 46 interviewed companies, 29 had experience with the metrological services of NIM. Their statements about these services vary from "normal" to "company does not receive any support from NIM, only formal inspections." What NIM provides are verifications. But this activity seems not to be pursued in accordance to the legal rules because NIM verification stickers were found without any documentation. Although several positive statements were collected, the statements shown in box III.2 are cause for concern.

Box III.2: Statements of the Interviewed Enterprises with Respect to NIM

- "NIM cannot calibrate new equipment from the EU and United States."
- "Good, but on old equipment."
- "Not effective, because NIM does not have the possibility of calibration of each type of equipment"

It is very difficult to assess the answers provided by companies, but they do give the impression that NIM's reputation could be improved. NIM is not considered competent with respect to training or verification and calibration of state-of-the-art equipment. The companies expressed a demand for NIM's services—especially verification and training—but on a more advanced level than currently provided.

Standards and Standardization

In most of the companies (29 out of 46), national Armenian standards are applied. ISO and IEC standards and EASC standards are used to almost the same extent.

The majority of companies purchase their standards from NIS. Companies mentioned that Armenian standards are very expensive. Membership in NIS includes accessibility to standards. Other sources are also used, such as customers, external partners, and the Internet (especially for international standards).

About 50 percent of the visited companies have interacted with the NIS Standards Committee. Their experience from such interactions varied from "good" to "negative," suggesting that there is room for improvement.

Most national Armenian standards are not harmonized with international standards. This lack of harmonization imposes additional costs on exporters because tests must be duplicated (box III.3), and it hampers the ability of many Armenian companies to export.

Product Certification

The study sought information regarding the recognition of the certificates provided by Armenian certification bodies. In many cases, the product certification was done by NIS, which is often perceived as the national certification body. That perception is incorrect, but it reflects the quasi-monopoly position of NIS.

The question about product certification recognition received inconsistent responses. The answers suggest that in most cases another product certification is necessary. Companies stated that products are certified on the basis of GOST standards, which are not recognized in the European Union and other regions worldwide. Moreover, even Russian importers distrust the testing results of Armenian laboratories and require a second test despite an agreement between Armenia and Russia on the mutual recognition of certificates.

Because the Armenian certification process is not recognized worldwide, another product certification based on standards recognized by the country of the buyer or customer is necessary, which means higher costs.

Membership in Business Associations

Of the 46 companies, 30 (65 percent) are members of any of 13 different entrepreneur's chambers of commerce or business associations, and 11 enterprises (24 percent) are members of more than one chamber or association. According to the interviewed companies, the key advantages of membership in these business organizations are:
- Links to the government
- Lobbying
- Discussion and seminars
- Training

In many cases, the activities and support provided by the organizations were unclear. Quality seems not to play an important role in the work of the business organizations.

Perceptions of Quality Infrastructure Suppliers

The companies were asked about their perception of the local QI suppliers—that is, NIM, NIS, and the Accreditation Agency of the Republic of Armenia (AA). Some companies stated that they had no contact at all with the QI suppliers. Even though the majority of the companies that had such contact were satisfied, the statements in box III.3 warrant serious consideration.

Box III.3: Statements of the Interviewed Enterprises with Respenct to QI Suppliers

- "A monopoly and ineffective"
- "An ineffective commercial organization"
- "Expensive, but not offering special support"
- "Corrupt and incompetent"

In most cases, the QI suppliers are not perceived as service suppliers, but as institutions that are earning (too much) money with little competence. As they are currently structured, the QI suppliers do not serve the industry; they in fact impede the development of industry.

Obstacles and Barriers to Competitiveness

The question about obstacles to competitiveness was asked specifically to obtain information about how the companies perceive the importance of quality to their competitiveness on the national and international markets. Obstacles identified by the companies included the following:
- Limited purchasing power (10 companies)
- Necessity of expensive product certification or approval abroad (five companies)
- Variation in currency (three companies)
- Poor quality of raw materials (three companies)
- Expensive raw materials (three companies)

Some other answers are listed below:
- No support for local manufacturers (a condition for development)
- NIS papers not acceptable in foreign countries
- Financing problems for details and certification process

- Personnel deficiencies
- Economy crisis and instability of the market
- Import and export regulations
- Customs problems
- Ineffective national calibration body
- Additional certification of products in Russia and other CIS member countries
- Lack of consumers
- Differences between local and international standards
- System of bank crediting that is not intended for manufacturers

The answers show that the enterprises consider the major problems to be the lack of financial resources, government support, and worldwide recognition of Armenian standards. In most of the companies, improvement and assurance of quality are not yet seen as crucial drivers for achieving competitiveness.

This lack of emphasis on quality as a barrier to competitiveness probably is found (a) because the domestic market seems to be a price-competitive market and (b) companies currently lack commercial relations with non-CIS countries. Solving these problems as a whole is a prerequisite for stimulating the Armenian economy.

2.2. Results of the Laboratory Survey

Methodology

Testing and calibration laboratories are a key element of a national quality infrastructure (NQI). They form the link between markets, consumers, and inspection and certification bodies. Hence, laboratories need to be independent and recognized nationally and internationally.

A total of 24 testing laboratories were surveyed, of which 10 were in-house laboratories of companies that had also been visited. Some of the ministries have their own laboratories; for instance, the Ministry of Agriculture has two laboratories, and the Ministries of the Nature Protection and Economy each have one. Only six of the laboratories visited are considered private and independent of the state. The vision for testing laboratories is incomplete and has to be supplemented.

The following criteria were used to make a first general evaluation of the laboratories' performance, conditions, and demand:

– Quality management

- Personnel
- Financial data
- Demand
- Infrastructure and environmental conditions
- Interlaboratory comparisons
- Equipment

As in the case of the companies, the cross-section of laboratories visited reflects the Armenian economic structure (table III.4). The majority of the laboratories were in the food and agricultural sector, but laboratories in the metallurgy, chemical, and pharmaceutical industries were also visited. The health sector was included because its importance is expected to grow in coming years because of increasing worldwide efforts to better measure quality in the health sector. Testing laboratories for the mechanical, textile, and leather industries could not be identified.

All laboratories visited were testing laboratories. Nine stated that they also carry out calibration and verification services, but more detailed questioning is needed to discover the scope of these activities.

Table III.4:   Sectors of Interviewed Laboratories

Sector	Number of active laboratories interviewed
Mechanical engineering	0
Textile industry	0
Petroleum industry	1
Metallurgy	3
Aluminum industry	1
Energy production	1
Agriculture and agroprocessing	8
Food and beverage industry	10
Retail market	1
Calibration laboratories	3
Pharmaceutical industry	3
Chemical industry	4
Cosmetic industry	1
Health care (for example, hospitals)	3
Construction	1
Services	5
State institutions (environment, waste water, drinking water, soil analysis, natural gas, and so forth)	8

Source: Survey.

Note: Sector classification was made by the laboratories themselves.

Quality Management and Accreditation

According to a government decision in Armenia, each certification body must have its own laboratory. This requirement is not found in Organization for Economic Co-operation and Development (OECD) and EU economies. Companies found the requirement to be problematic because the impartiality of the laboratory results is not ensured. Several mentioned that they had no confidence in the results of such laboratories. They also underlined that more competition is necessary so that the quality of test results will improve and prices will diminish.

Of the 24 laboratories surveyed, 11 (46 percent) were certified under ISO 9001. Most did not state the certification body in charge. Only four laboratories answered this question and their answers were confusing.

Of the 24 laboratories, 6 (25 percent) were accredited under ISO/IEC 17025. Two stated that the Ministry of Economy was the accreditation body in charge. Several laboratory staff members who were interviewed commented that the Accreditation Agency (AA) lacks competence. It needs experts who have more knowledge about ISO/IEC 17025. The accreditations of AA are not internationally recognized; they have significance only in Armenia. Therefore, laboratories that are accredited according to ISO/IEC 17025 by AA complain about the absence of recognition of their accreditation in foreign countries.

The NIS food laboratory is a special case. For a long time, it was the only product certifier in Armenia, and it still is perceived as the "national certification body." According to the NIS food laboratory, the samples it receives from the NIS Certification Division are anonymous; thus, the laboratory does not know from which customer a sample was taken. But this statement is doubtful, specifically because there are no strong firewalls between the different divisions. Surveyed companies expressed no confidence in the independence of the government laboratories in general.

The number of accredited laboratories is very small. Implementing a QMS (according to ISO 9001, ISO 14000, or good manufacturing practice criteria) appears to be of little importance for laboratories. Major obstacles are the lack of competence of the national accreditation body and the lack of international recognition of its accreditations.

Personnel

The number of employees varied from 5 to 150, but apart from the three large government-owned laboratories, the average number of laboratory staff was 15.

A much greater percentage of the staff comprised technical experts than scientific and administrative personnel. This proportion seems reasonable.   The age structure of employees seems balanced (table III.5).

Table III.5:   Age Structure

Age of staff members	Number of employees
Less than 30 years	30
30–40 years	60
40–50 years	87
More than 50 years	45

Financial Data

Data on financing were obtained to evaluate the independence of the laboratories. Of the 24 laboratories, 11 (46 percent) were fully financed by the services they performed. Eight received government benefits. One laboratory (Environmental Impact Monitoring Centre), which is part of the Ministry of Nature Protectionwas fully financed by the state. Some financing for the laboratories came from projects of international donors.

Eleven laboratories used a price list as their basis for charging for services performed. These laboratories provided their services to external customers. Except for those that were government owned, laboratories, as a rule, established their own prices, and the general manager or director confirmed the prices. Of the 13 laboratories that had no price list, 10 were in-house laboratories.

In most of the cases, the following criteria were considered in the determination of prices:

- – Work expended per measurement
- – Administrative expenditure
- – Capital investment for the laboratory
- – Standing operating expenses for the laboratory

Demand

Laboratories were asked about the market demand for their services, including the number of tests performed and whether any customer demands could not be met. The average number of tests performed annually in in-house laboratories was 40,000. For laboratories providing services to external customers, the average number was 35,000 per year (see table III.6).

Table III.6:   Number of Tests Performed, 2008

Type of laboratory	Number of tests (range)
Laboratories providing services to external customers	200–130,000
In-house laboratories	400–170,000

Hence, for a laboratory that operates on a five-day cycle, about 150 tests are performed per day. That number seems relatively high considering the size of some of the laboratories. In some of the bigger laboratories visited, only a few real testing processes could be observed.

Two-thirds of the laboratories stated that all customer demands could be met. Only one-third communicated that they lacked of specific devices, especially for the following analyses:
  – Genetic diseases
  – Electromagnetic compatibility analyses (lack of an anechoic chamber)
  – Radionuclide analysis
  – Heavy metals
  – Toxic elements
  – Radioactive materials

In addition to these equipment needs, the following requirements have been communicated:
  – Metrological support
  – Accreditation and certification

Infrastructure and Environmental Conditions

To the extent possible, laboratory facilities were visited and evaluated. In addition, laboratory representatives were asked to assess infrastructure and environmental conditions. The focus was on the following issues:
  – Functioning of an air-conditioning (AC) unit
  – Environmental conditions and requirements
  – General conditions (such as space)
  – Technical installations, electrical power, and so forth

Although 20 laboratories claimed to have an air conditioning (AC) unit installed and functioning so that temperature limits could be controlled, only in a very few cases was the AC unit switched on during the visit. Moreover, 20 laboratories stated that their processes required relative humidity to be controlled too, but almost all AC units observed were split

units, which cannot control relative humidity. Thus, it seems that environmental conditions are not considered very important for testing results. One must assume that most of the laboratories visited did not know about the specific requirements for the tests performed.

A serious problem for some laboratories was the instability of the electric power supply. Eight laboratories experienced regular blackouts (from one per season to one per day). Most laboratories have emergency power supplies installed. The problem, however, is serious, because a loss of power may damage highly delicate analytical equipment.

All self-assessments by the laboratories were relatively positive, although several stated that they needed more space.

The most important environmental problems are inappropriate handling of AC humidity control according to climatic conditions in Armenia and instability of the electric power supply.

Interlaboratory Comparisons

Eighteen laboratories had already participated in proficiency testing. Some interlaboratory comparisons were international (for example, with the World Health Organization, a Belgium hospital, and laboratories in Georgia and Norway). The Yerevan Water Company and SIS Natural LLC claimed to have participated in intercomparisons with NIM. The status of these comparisons should be verified. In any case, however, the number of intercomparisons was too low.

Laboratories still consider intercomparisons to be measures of supervision by the accreditation body, and not opportunities to identify potential areas of improvement or to demonstrate capabilities and competence.

Equipment

In general, the surveys show that the level of equipment varies. Some laboratories use equipment dating from the Soviet era, while others are equipped with state-of-the-art instruments for microbiological and other analyses. Most of this modern equipment cannot be calibrated or verified by NIM, although NIM verification stickers can be found on most instruments. Therefore, one must assume that in many cases no traceability is ensured.

2.3. Identified Demand for Metrology Services

The surveys of the laboratories and enterprises give evidence that Armenia still has no functioning NQI. Every The most important gap is the lack of international recognition of the national accreditation body and NIM.

Another identified problem is the lack of funds for investments in laboratories and companies, as well as in NIM.

Companies often see calibration and verification as a state control and not as a guarantee of reliable measurements and high-quality products. The results of NIM's verifications are not questioned. This problem can be traced to the law and to a lack of awareness.

To identify the demand for metrology services, companies and laboratories were asked for lists of equipment used. Only a few of them had readily available lists (which is a crucial prerequisite for good QM). Others sent lists after the initial interview. But overall these lists indicated very poor knowledge about measurement equipment in both companies and laboratories. The lists were fragmented and incorrect. Only 20 percent of the equipment was listed with range and accuracy data, and in such cases, another 30 percent of data were inconsistent and obviously wrong.

However, from the available data, a first overview is given on identified demand. The focus is on the major quantities required. As mentioned, because of lack of information it is not always possible to derive the required range. In these cases, recommendations are given.

Industrial Metrology

Basic Physical Quantities

On the basis of the surveys with companies and laboratories, requirements for metrological services can be found for the following basic quantities:

- o **Mass:**
  - ⇒ *Weighing instruments (all types of balances):*
    Accuracy: All types (analytical balances, precision balances, trade and industrial balances)
    Range: 0–50 t
  - ⇒ *Weights:*
    Accuracy: International Organization of Legal Metrology (OIML) Classes F1–M3
    Range: 0–20 kg

- o **Temperature:**
  - ⇒ *Liquid-in-glass thermometer*
    Range: −50–400 °C
  - ⇒ *Digital thermometer*
    Range: −50–750 °C

- o **Pressure:**
  - ⇒ *Manometers, pressure gauges*
    Range: 0–40 MPa

- o **Electrical quantities:**
  - ⇒ *Direct current or alternate current*
    Range: (0–20) A
  - ⇒ *Direct voltage or alternate voltage*
    Range: (0–1,000) V
  - ⇒ *Oscilloscopes*
    Range: (0–100) MHz

- o **Relative humidity:**
  - ⇒ *Humidity sensors*
    Range: 0–100 percent relative humidity

- o **Length (dimensional):**
    - ⇒ *Rulers or tapes*
        - Range: 0–20 m

Physicochemical quantities

The food and food-processing sector is the most important sector in Armenia. Traceability of the following chemical quantities must be possible in the short term to ensure adequate food safety and, for companies entering the global market, to meet international requirements. Traceable calibration of the corresponding equipment also needs to be provided.

- o **pH:**
    - ⇒ *pH meters*
        - Range: 0–14 pH

- o **Electrolytic conductivity:**
    - ⇒ *Conductivity meters*
        - Range: 1–150 mS/cm

- o **Liquid density:**
    - ⇒ *Density meters*
        - Range: (700–2,000) kg/m³

Chemical-Analytical Quantities

Medical and analytical laboratories are special cases. Their equipment is very specific and requires specific measurement standards (particularly Certified Reference Materials for chemical-analytical measurements, important for the food sector) to be inspected and calibrated. For technical reasons, traceability is sometimes difficult to ensure. In some cases, so called controls are available to regularly adjust these instruments. The user normally performs these adjustments. However, metrologists from NIM can also use the controls to check these devices.

A summary of the most frequently used equipment follows:
- ⇒ Gas-liquid chromatography equipment
- ⇒ High-performance liquid chromatography equipment
- ⇒ Atomic absorption spectrometer
- ⇒ Photometer or spectrophotometer

$\Rightarrow$ Photoelectric calorimeter

$\Rightarrow$ Refractometer

Legal Metrology

A major task of legal metrology in terms of consumer protection is ensuring adequate supervision of the following devices used in households:

$\Rightarrow$ Domestic electricity (power) meters

$\Rightarrow$ Domestic gas meters

$\Rightarrow$ Domestic water meters

Regular supervision of all domestic equipment is still not fully ensured. In particular, the regular inspection of gas meters is not guaranteed. NIM depends too much on measurement facilities and capabilities of private companies and providers of energy, water, and gas.

Furthermore, an urgent demand was identified for the inspection and monitoring of petrol stations. Many of these stations—especially those providing natural gas—are equipped with devices that do not measure flow properly and hence do not ensure adequate consumer protection. NIM urgently needs to take action to ensure a minimum level of measurement capability and traceability at all petrol stations.

With regard to verification of measuring equipment, the following quantities have been identified as having the highest demand:

o **Mass:**
   $\Rightarrow$ *Verification of weighing instruments used for commercial purposes*
   Range: 0–50 t
   $\Rightarrow$ *Verification of weights*
   Accuracy: OIML Classes E2–M3
   Range: 0–20 kg

o **Electrical quantities:**
   $\Rightarrow$ *Verification of electrical power meters*

o **Volume / density:**
   $\Rightarrow$ *Graduated cylinders, glassware, pycnometers*
   Range: 100 mL–2 L
   $\Rightarrow$ *Storage tanks*
   Range: up to 500 L

$\Rightarrow$ *Fuel dispensers*

In addition to these technical needs, several laboratories expressed a need for metrological consultation and training. NIM definitely needs to develop this field of activity.

3. The Institutional and Legal Framework of the National Quality Infrastructure in the Republic of Armenia

3.1. The Current Legal Framework

The current legislation about the quality infrastructure (QI) was approved in 2004. The three basic laws are:

1. The Law on Standardization, which addresses technical regulations and standards.
2. The Law on Conformity Attestation, which deals with conformity assessment and accreditation.
3. The Law on Assurance of Uniformity of Measurements, which addresses metrology.

These laws are complemented by a series of government decrees that define the institutional structure and the tasks of the new institutions:

- Government decree 1038-N of July 22, 2004, on recognizing the national standards body and National Institute of Standards
- Government decree 1032-N of July 22, 2004, on recognizing the national metrology body and National Institute of Metrology
- Government decree 1031-N of July 22, 2004, on recognizing the national conformity assessment body
- Government decree 1938 of December 19, 2004, on defining measurement units, symbols, writing, and rules of their application
- Government decree 1149-N of July 29, 2004, on obligatory conformity assessment (ed. September 20, 2008)

Procedures for developing and implementing technical regulations are currently fixed by government decree 9 of January 11, 2000, on approval of the procedure for preparing, adopting, and applying technical regulations

The laws and decrees are widely inconsistent with international standards and rules. The obligatory and the mandatory elements are not defined according international practices.

The government is aware of this situation and, for this reason, developed new drafts (on measurement and accreditation). These drafts represent a step in the correct direction, but they suffer from deficiencies:

- The terminology in the legislation is not yet in accordance with the international standards and definitions—ISO (International Organization for Standardization)/IEC

(International Electrotechnical Commission) series 17000, International Organization of Legal Metrology recommendations, and International Laboratory Accreditation Cooperation (ILAC) and International Accreditation Forum guides.

- In many cases, the formulation does not correspond to the international standards.
- In some cases, the drafts are too concrete and overemphasize national exceptions.

These deficiencies produce the following risks:

- The legislation will become obsolete and have to be adjusted or newly formulated in a short time.
- International recognition of the conformity assessment certificates will be impeded.

3.2. The Current Institutional Framework

In the Republic of Armenia, the vertical responsibility for developing the QI and its institutions is clearly defined. It is in the hands of the Ministry of Economy. Within the ministry, some changes were made during the current government to make the structure more efficient (figure IV.1).

Figure IV.1:   Organization Chart of the Ministry of Economy, December 2009
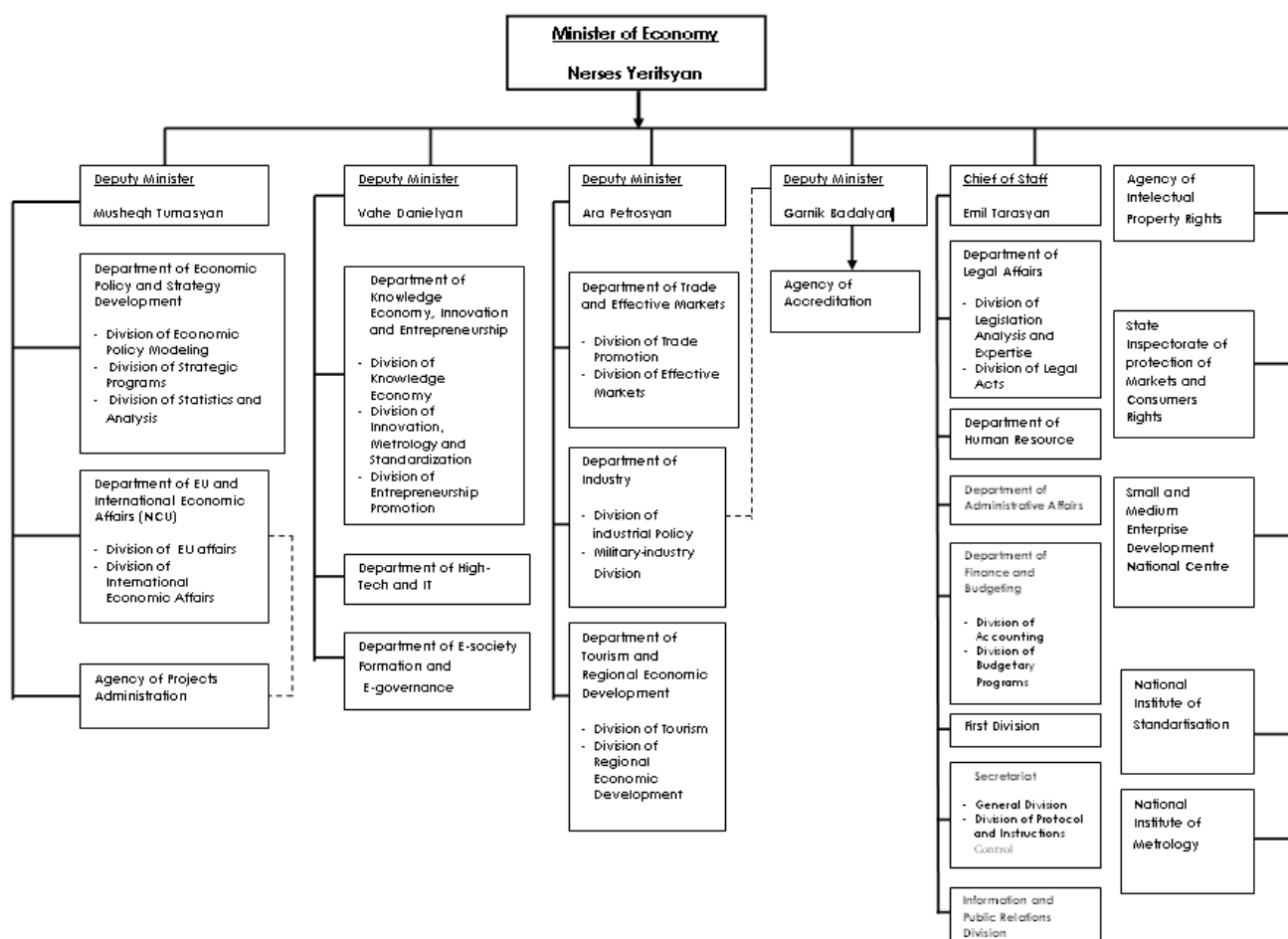
Source: Authors' elaboration

The policy for developing the national quality infrastructure (NQI) was concentrated in the Division of Innovation, Metrology, and Standardization, which is expected to implement NQI reforms in the coming years. The representation of the Republic of Armenia in the EASC is the responsibility of a Deputy Minister of Economy.

As a consequence of the reform of 1999 and the important amendments of 2004, the former Gosstandart Body of Armenia was dissolved and four formally separate institutions were founded:

- The National Institute of Standards of Armenia (NIS)
- The National Institute of Metrology of Armenia (NIM)
- The Accreditation Agency (AA)
- The State Inspectorate for Market Surveillance and Consumers Right Protection.

NIS and NIM are closed state stock companies reporting directly to the minister of economy. AA and the State Inspectorate for Market Surveillance and Consumer Rights Protection are departments of the Ministry of Economy.

Undoubtedly, separating the QI institutions and the vertical responsibility of the ministry is still in progress. Many weaknesses still impede the effectiveness of the system, particularly the transparency and reliability of the policy. The most important elements are the following:

➢ True political independence of the four institutions is not possible. The AA and the State Inspectorate for Market Surveillance and Consumer Rights Protection are departments of the ministry. Certificates of accreditation are signed by the minister, as are standards. NIM and NIS are formally independent state enterprises, but their budgets are approved by the ministry and formal representation in international organizations is also held by the ministry.

➢ The horizontal lines within the Armenian government are not clearly regulated. Technical regulations have to be reviewed and approved by the Ministry of Economy, but for other items, the horizontal coordination between the relevant ministries (the Ministries of Agriculture, Nature Protection, Urban Development, Energy and Natural Resources, Health, Justice, and Emergency) is unclear.

➢ Stakeholders, especially the private sector and the consumer and environment protection organizations, are not represented, at least at all levels of the system. The only exception is their formal participation in the accreditation process.

➢ The relationship among the different elements of the system is not defined.

➢ To a great extent, some inspections are conducted without a real relationship to the core QI institutions.

➢ The management system and the results (certificates) do not adhere to international standards and best practices

That the State Inspectorate for Market Surveillance and Consumer Rights Protection is organized as an inspectorate and that its tasks are not defined according to international practices is another issue that must be resolved.

3.3. State Promotion of QI Activities

The Ministry of Economy has relationships with some of the business associations and individual enterprises in which the assurance and the certification of quality plays a role. There are no special promotion programs in the form of trainings, subsidies, or credits that could improve the situation in testing laboratories or could help implement quality management systems (ISO/IEC 9000, ISO/IEC 14000, and HACCP) in interested small and medium-size enterprises.

3.4.   Entrepreneurial Organizations and QI

Armenia does not have a strong entrepreneurial sector. Some entrepreneurial organizations, such as the Republic Union of Employers of Armenia or the Union of Constructors, exist, but they seem to be more concerned about political lobbying than delivering services to their members (see chapter 3). Nevertheless, discussions in the Chamber of Commerce and Trade of Yerevan and the Republican Union of Employers demonstrate that awareness of the problem is increasing. However, entrepreneurs seek individual rather than general solutions, partly because they are disillusioned by the services offered by the current NQI institutions. These institutions are viewed very skeptically and are identified with state control and corruption. Enterprises prefer to work with private consulting firms, which help them prepare for quality management certification.

3.5.   Nongovernmental Organization Activities in the Field of Consumer Protection

In the field of consumer protection, three nongovernmental organizations (NGOs) are active. One of them, the Protection of Consumers' Rights (PCR),[8] was visited. Since 1998, PCR has been a member of the Consumers' Federation of the Caucasus, and since 1999—like other consumer organizations in the former Soviet Union—it has been a member of Consumers International.[9]

PCR's main activities are
  − Advocacy, lobbying, and campaigning
  − Consumer awareness raising
  − Consumer consulting and advice
  − Action-oriented research
  − Organization of trainings and seminars

The NGO has six full-time staff members. It also makes use of volunteers and trainees. A substantial amount of financing comes from foreign donors.

PCR is member of the Accreditation Council of the national accreditation body (NAB). It is aware that the NAB's procedures are not in accordance with international best practices.

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[8] PCR's Web site is http://www.consumer.am.
[9] Consumer International's Web site is http://www.consumersinternational.org.

One of PCR's main activities at the time of the visit was monitoring complaints about contracts, time measurement, and mobile phone invoices. It also was attempting to prove the conformity of foodstuffs. Obligatory foodstuff inspections were canceled in May 2009. Hence, the NGO tries to investigate quality problems indicated by consumers. The NGO prefers to use the testing services offered by the private Mavas Group instead of those of NIS.

Consumers seem to be aware of the existing problems with the quality (and quantity) of foodstuffs (and other products), but they are too concerned about their own daily struggles to be active. Their willingness to report problems is not well developed, and they do not yet have the expectation to get their complaints resolved. A more active provision of information by government institutions and the media about quality problems and the dangers of foodstuffs, electrical household devices, toys, and so forth is also lacking.

One of the three consumer protection NGOs in Armenia operates a testing laboratory and certification body.

3.6.   International Cooperation

Generally, the international relations of the Armenian NQI institutions are only weakly developed, and cooperation with other institutions is not yet very active.

Armenia is a member state of the EuroAsian Interstate Council for Standardization (EASC). It is usually represented in the EASC by a deputy minister of Economy and some experts from the NQI institutions. After the breakdown of the Soviet Union, the main standardization activities of the region have been implemented by EASC. Comparable importance was not given to other organizations (except for ISO). Only in the past three or four years has more interest in such organizations been observed.

NIS is an ISO member, and it currently has 33 participating and observer memberships in ISO technical bodies. Currently, with only six national committees formally established, one may assume that NIS's ISO committee memberships are primarily formal, academic exercises. NIS is also an affiliate member of the European Committee for Standardization, which allows it access to European standardization documentation and participation in the General Assembly and technical committees as an observer. However, Armenia is a member of neither the IEC nor the European Committee for Electrotechnical Standardization.

Only since 2007 has the Ministry of Economy been represented by NIM as a member of the Euro-Asian Cooperation of National Metrological Institutes, the regional metrology organization.

The national accreditation body was once an affiliate member of ILAC, but it lost its status because of lack of money and insufficient awareness of the importance of participation in this international organization of laboratories.
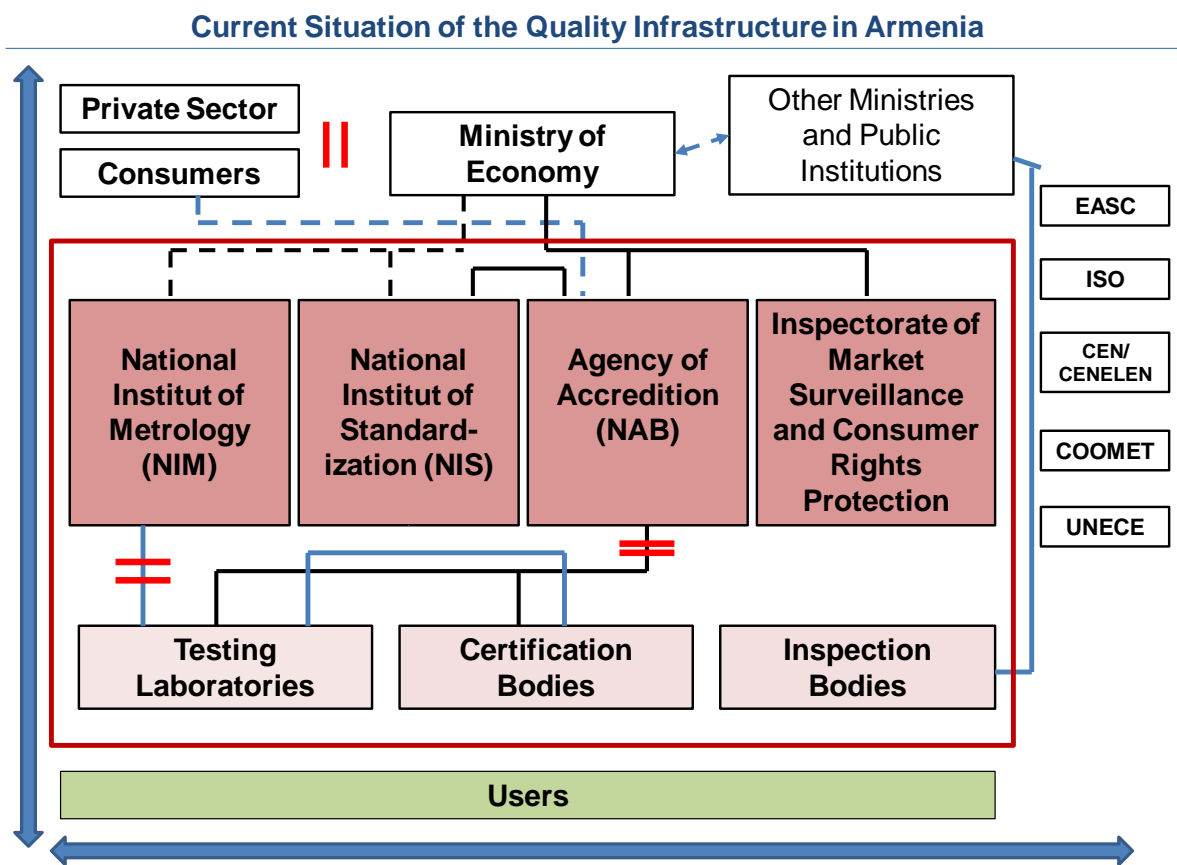
The isolation of Armenia within the network of international QI organizations is a factor in the current status of the NQI.

3.7. Overall Assessment

In sum, although a certain formal NQI structure exists in Armenia (figure IV.3), it faces the following constraints:

➢ The legal framework does not correspond with international standards, recommendations, and best practices.
➢ Stakeholders—particularly the private sector and consumers—are underrepresented in the system.
➢ Coordination between the Ministry of Economy and the other relevant ministries is not clearly defined;
➢ Development has occurred to a great extent without relations with international QI organizations.
➢ The relationship between the main NQI institutions is not clearly regulated in accordance with international standards and best practices.

Figure IV.3:   Current Situation of the QI Institutions in Armenia

Current Situation of the Quality Infrastructure in Armenia

| Private Sector |
| Consumers |

Ministry of Economy

Other Ministries and Public Institutions

EASC

ISO

CEN/ CENELEN

COOMET

UNECE

National Institut of Metrology (NIM)

National Institut of Standard-ization (NIS)

Agency of Accreditation (NAB)

Inspectorate of Market Surveillance and Consumer Rights Protection

Testing Laboratories

Certification Bodies

Inspection Bodies

Users

Source: Authors' elaboration

Note: dotted lines represent missing links;

4. Components of the Quality Infrastructure in Armenia

This chapter relies on the results of:
- The demand survey (see chapter 3)
- An assessment of the National Institute of Metrology (NIM) and metrological services in Armenia
- An assessment of the national accreditation body
- An assessment of the situation of standardization and technical regulations.

This chapter reflects only the most important general findings and recommendations.

4.1. The National Institute of Metrology

International Recognition

Achieving international recognition is NIM's highest priority. The road to international recognition, whether through accreditation by an internationally accepted accreditation body or an independent peer review of the institute's technical capabilities, includes at least the following milestones:
- Availability of traceable standards and equipment that meet metrological needs and serve as national measurement standards
- Specifically qualified and competent laboratory personnel
- Implemented and validated calibration and verification procedures
- An implemented quality management system that meets international requirements (ISO/IEC 17025: General Requirements for the Competence of Testing and Calibration Laboratories)
- Successful participation in key interlaboratory comparisons, which result in the publication of the calibration and measurement capabilities of the NIM laboratory in the Key Comparison Database (KCDB) of the Bureau International des Poids et Mesures.

Once these milestones are successfully accomplished, NIM will be in the position to sign the Comité International de Poids et Mesures (CIPM) Mutual Recognition Agreement (MRA). This international arrangement between national metrology institutes (NMIs) was established to enable the mutual recognition of national measurement standards and of calibration and measurement certificates issued by NMIs.

Given the current state of the Armenian metrology system, the process of international recognition is expected to take at least six years, beginning from the time when appropriate

laboratory facilities for scientific and industrial metrology become available. Such facilities are an essential prerequisite.
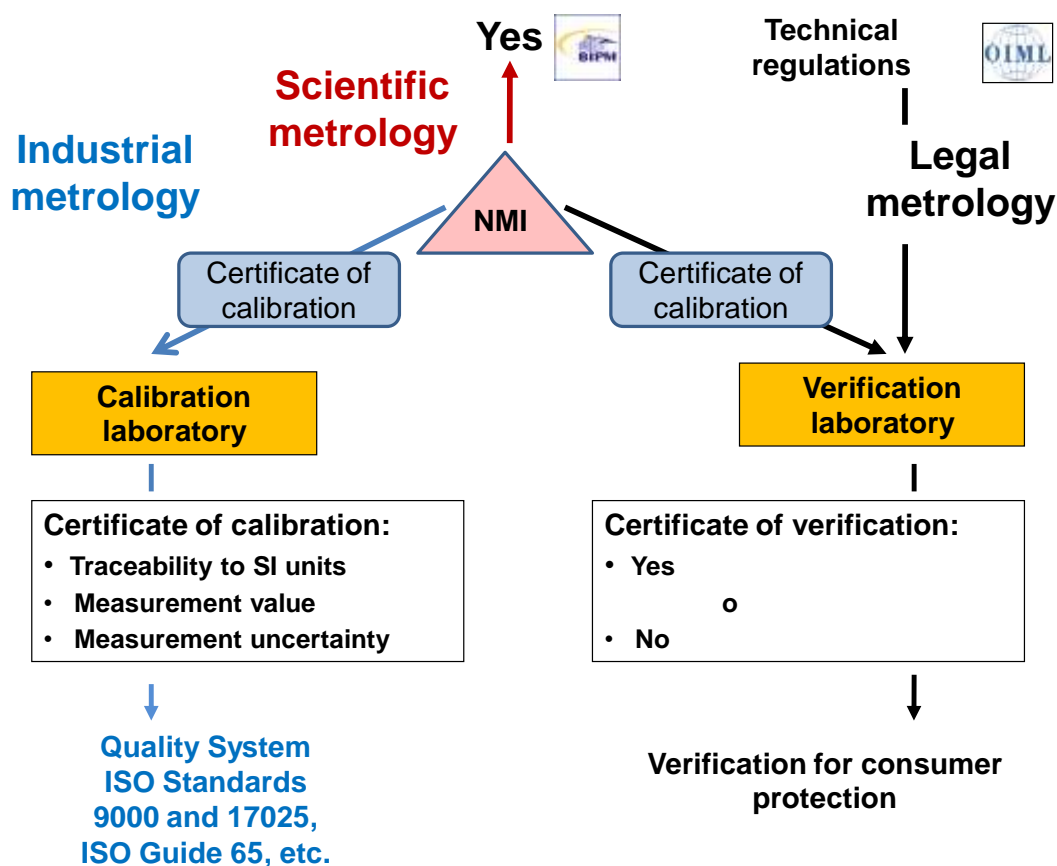
Scientific and Applied, Industrial, and Legal Metrology in Armenia

In most countries, metrology is separated into three categories (see figure V.1):

1. **Scientific and applied metrology:** At the highest level (a level fit for and addressing the countries' needs), such metrology develops and maintains the national measurement standards. It ensures the traceability of measurements to the International System of Units (SI). It provides traceability to industrial and legal metrology.
2. **Industrial metrology:** Such metrology provides traceability to measurement instruments used in industry by calibration.
3. **Legal metrology:** Such metrology ensures adequate consumer protection by verifying the measuring instruments used for commercial transactions, in health care, and for safety purposes.

Industrial and legal metrology depend on scientific and applied metrology, which ensures the traceability of measurements and hence their reliability and comparability.

Figure V.1: Traceability Chain of Scientific, Industrial, and Legal Metrology

Source: Authors' elaboration

NIM does not follow international standards in terms of its scope of activities. Scientific and applied metrology and industrial metrology, which secure the traceability of measurements, are missing in Armenia. Only legal metrology is implemented, but with a lack of evidenced traceability. Armenian enterprises need calibration services for their measuring instruments, including the determination of specific metrological characteristics according to their needs and taking into account the concept of measurement uncertainty. Currently, such services are not available.

Legal and Institutional Framework of the Metrology

The current legislation on metrology (the Law of the Republic of Armenia on Ensuring Uniformity of Measurements) has been in place since 2004. This law also defines NIM's responsibilities and powers. NIM has drafted a new law on metrology, but it also has shortcomings.

NIM has little autonomy. It is a closed state stock company that reports directly to the Minister of Economy. It is very dependent on the decisions of the Ministry of Economy (MoE). According to its own statement, NIM has autonomy and authority only to select its workforce and to offer new services and initiate new activities. It is self-financed by the income from verifications, but not by fines. Occasionally, the state finances small investments. NIM's annual budget is approved by the minister of economy.

Industry, the scientific community, and consumer protection organizations are major stakeholders of the local quality infrastructure in general and of metrology in particular. Their representatives need to be involved in important decision-making processes and even legislation. To do so, they need to be part of a board of trustees, which acts as advisory board. At the time of the study, no formal contacts between these stakeholders and NIM existed. The government must have a yearly budget for NIM.

Equipment

A country's NMI should ensure the traceability to the SI of measurements taken in the industrial and scientific sectors and of those sectors subject to state control. Thus, an NMI should offer the highest level of measurement accuracy and technical competence, on a level that addresses the needs of the country. In Armenia, such traceability is not currently ensured.

The equipment of the NIM laboratories is obsolete and lacks calibration. It is widely out of date, and many of the measurement reference standards are not calibrated. Hence, traceability to the SI is not ensured for all metrological parameters.

The laboratory infrastructure (accommodation) does not meet current and future requirements in terms of condition (construction and environmental), space, and structure. current facilities pose barriers to the harmonization of the laboratory structure with international rules (that is, rules requiring operation of separate laboratories for different quantities, such as mass, temperature, volume, and pH).

Personnel

Changes are needed regarding numbers and qualifications of personnel (see table V.1). The current number of 144 staff members is very high. Also, there is a high percentage of administrative personnel (approximately 40 percent). Specific training of staff members

predates 1991. The concepts of a traceability chain and estimation of uncertainty are only theoretically known by some of the leading experts.

Table V.1:   Current Numbers and Qualifications of NIM Staff Members

Position	Number of staff members
Scientists and engineers	64
Of which have PhDs	5
Technical staff members	24
Administrative staff members	56
Total	**144**

Source: Authors' elaboration

Another challenge is NIM's age structure (see table V.2). Although NIM's general director has hired some young people, the age structure is not very promising. And without better salaries; better working conditions (that is, modern equipment); and better development perspectives, these young people will leave the institute sooner or later for better opportunities in private business.

Table V.2:   Age Structure of the NIM Staff

Age	Number of employees
Less than 30 years	24
30–40 years	23
40–50 years	25
More than 50 years	72

Source: Authors' elaboration

Current Services of NIM

NIM's legal metrology activities are still based on GOST standards instead of International Organization for Legal Metrology (OIML) recommendations. And because reliable traceability does not exist, verifications are doubtful. Often the measurement equipment in enterprises is too recent to be verified by NIM's instruments and measurement methods; hence, in many cases, verification is only a formality. Because of the lack of a metrological base, one may

assume that the situation is similar in most of the inspections carried out in enterprises by law. These inspections appear to be activities for earning cash rather than activities for securing life and health.

NIM is responsible for regularly verifying measuring instruments installed in households, such as electricity, water, and gas meters. No continuous legal supervision is available. More technical independence from local providers of gas, water, and electricity is necessary.

The lack of post-1991 trainings, the obsolete equipment, and the lack of traceability mean that NIM, in effect, does not offer calibration services for industry. Moreover, many small and medium-size Armenian enterprises do not know what calibration means, because they produce overwhelmingly for the domestic market, where accurate measurement is not expected. For the majority of the NIM staff and the majority of entrepreneurs, metrology is considered to be a state control and not a service that helps producers and consumers.

Requirements for the Development of NIM's Metrological Services

NIM does not follow international standards in terms of its scope of activities. In Armenia, only legal metrology is implemented, but in an insufficient way because the traceability of the measurement standards is not ensured. The calibration certificate of the national kilogram standards dates from 1995. Armenian enterprises need calibration services for their measuring instruments, including the determination of specific metrological characteristics on the basis of needs and the provision of information on measurement uncertainty. Currently, such services are unavailable.

The weak situation of metrology is a critical barrier to the future economic and social development of Armenia. The responsibility for this situation lies less in poor management of NIM than in a lack of awareness of the significance of metrology. In the Soviet Union, the GOST systems ensured accuracy of measurement that met the needs of the system, but now the republics that evolved out of the Soviet Union need to realize that they require basic metrological services if they are to develop further and join the international economic system.

4.2. The National Institute of Standards

Interest in standards comes from the industry itself, in addition to other stakeholders, such as the government, consumers, and the scientific community. According to international practices reflected in the WTO TBT Agreement's Code of Good Practice, standards are not

determined by law, but by interested parties who obligate themselves to respect such standards. Standards are consented on by the interested actors, who are mainly from the private sector, and they have a voluntary character. If they are applied by industry and other interested parties on the basis of agreements, they are declared obligatory and form the basis for judicial trials.

In many countries, standardization bodies are private institutions. Enterprises and other interested parties establish standardization committees that elaborate the standards according to the most important technological advances.

The task of a standardization body is to ensure the following:
- The standards fulfill the formal requirements of a standard in the national and international context and—as in the case of the European Union—also the regional requirements
- All interested national and international parties have access to the national and international standards. For this reason, all the standardization bodies have a documentation and information center. In some countries, the technical barriers to trade are also situated in the institute of standardization.

Standardization bodies work in very close contact with international organizations such as the International Organization for Standardization (ISO) and the International Electrotechnical Commission (IEC). They are also members of regional standardization organizations such as the European Committee for Standardization (CEN) and the European Committee for Electrotechnical Standardization (CENELEC). Because of globalization, ISO and IEC norms have become increasingly important; thus, a main obligation of the standardization bodies is to determine which standards are being used and to adapt the ISO and IEC standards to national conditions. In many cases, they only translate (if necessary) the standard into the local official language.

The Legal and Institutional Framework

The National Institute of Standards (NIS), which for international purposes uses the name SARM, or Standards of Armenia, is a closed state stock company, which reports directly to the Minister of Economy. In general terms, it is self-financed by its services. However, in formal and legal terms (that is, under the relevant legislation in place), NIS is neither the national standards body (NSB) nor the national conformity assessment body (CAB), which in both cases is the MoE. In the area of standardization—and specifically for the purposes of membership in regional and international organizations such as CEN, the EuroAsian

Interstate Council for Standardization (EASC), and ISO—the NSB function is, however, acted out by NIS. The Standardization Department at the MoE was dissolved in 2008. Its political function is exercised by the MoE's Division of Innovation, Metrology, and Standardization. Until 2008, NIS was officially responsible for the elaboration of technical regulations (TRs). Now, TRs are developed by the respective line ministries (Ministries of Health, Urban Development, Agriculture, and so forth), but supervision and control rest with the MoE.

NIS comprises the following major functional divisions:
- Standardization Division
- Certification Division
- Testing Division
- Training Center

All four divisions are managed by heads of division, who report to the director of NIS. The responsibility for operations in all four areas lies with the director of NIS.

The largest and most urgent problem in the field of standardization in Armenia is the almost complete lack of stakeholder participation:
- Drafting the annual work plan for standardization is a purely academic exercise that in no way is based on articulated stakeholder needs. Work in technical committees is in its infancy at best. Few enterprises take part in the committees.
- Draft standards foreseen for national adoption (for example, ISO final draft international standards) are circulated to a select group of potentially interested parties, but almost no comments are received (in part because of the language barrier).
- National standards are approved by the NIS Scientific Board, which submits justified recommendations to the minister of economy for approval. Without final formal approval, the standard will not be valid. Members of the Scientific Board are mainly from the ministries and other state organizations. The board is headed by the director of NIS.

Personnel

NIS has about 130 staff members, including those in the Certification Division and the Testing Laboratory. Approximately 35 percent are administrative personnel, which appears to be a very high percentage. Given the population of the country (3.2 million) and its economic structure, 12 to 20 employees ought to be enough (table V.3).

The high percentage of highly qualified personnel (see table V.4) suggests that many worked under the Gosstandart system. In some cases, the influence of the Gosstandart mentality can still be perceived and is an obstacle to good cooperation with industry, one of NIS's main stakeholders.

Table V.3: The Composition of the NIS Staff

Division	Number of staff members
Administration[a]	46
Standardization	23
Elaboration of standards	15
Information center (including technical barriers to trade)	8
Certification	42
Testing laboratory	17
Training center	3
Total	131

Source: NIS.

a. Includes security, cleaning, and so forth.

Most staff members received their last training in standardization before 2000. Obviously, the majority of staff members have had little to no exposure to European or international practices, as found in advanced NSBs, but they are fairly open to recommendations and are committed to their tasks.

Table V.4: Qualifications of the NIS Staff

Educational degree	Total number	Number working in standardization
Scientists and engineers	99	18
Of which have PhDs	9	1
Technical level	21	5
Auxiliary staff	11	0

Source: NIS.

Table V.5:   Age Structure of the NIS staff

Age	Total number	Number working in standardization
20–30 years	26	10
30–50 years	51	6
50–60 years	36	3
More than 60 years	18	4

Source: NIS.

With respect to age structure, the situation is better than that of NIM. In particular, the Standardization Division has a substantial number of staff members under 30 years (table V.5).

Armenian Standards and Harmonization with European and International Standards

By law, Armenian standards are voluntary. This point is not clear to all entrepreneurs; many think the standards are still mandatory.

The total collection of Armenian normative documents (National Fund of Standards) comprises approximately 20,000 documents. About 25 percent of these documents are technical specifications, which are drawn up by individual companies for the registration and certification of their products. The large majority, however, are GOST standards from different sources:

- GOST R (Russian Federation)
- GOST ISO and IEC
- GOST EN (European).

According to NIS statements, the standardization practice in Armenia, which is based on the Law on Standardization, is oriented toward the following principles:
- Consistency with European and international standards
- Consistency with World Trade Organization (WTO) technical barriers to trade (TBT) principles
- Consistency with ISO Guide 21 ("Adoption of International Standards")

All standards applied in Armenia must be in Armenian. This rule produces high translation costs with doubtful results. In most countries, translation is done only for the standards that are most used; others are available only in English. Many ISO and IEC standards also exist in Russian, but using the English version is recommended because the Russian translation may not be correct.

Another weak point is the practice of registering of technical specifications. These specifications are typically a remnant of the old Soviet standardization system. They are allegedly either used in production areas for which there are no standards, owing to insufficient demand and interest (only few producers), or drawn up in cases where the standards contain only very general requirements and more specific criteria are deemed necessary for certification purposes. Technical specifications may cover specific national products, such as Armenian cheese or yogurt. They are drawn up by individual producers for selected products of their own production. NIS then uses the technical specifications to check if the production output is and remains in compliance with the specifications. This registration is definitely not in line with international standardization and conformity assessment practice and should be gradually abandoned.

NIS currently has six technical committees (table V.6), but not all of these committees are probably active.

Table V.6:   NIS Technical Committees

Technical committees	Represented enterprises
Foodstuffs	3
Mineral water	4
Energy	5
Pharmaceutical products	1
Fruits and canned food	3
Dairy and dairy products	3

Source: NIS.

Little of what NIS is doing in the standardization field is really embedded in and legitimated by stakeholder needs and interests. There were complaints from the productive sector (for instance, construction) that requests to establish new technical committees were denied for lack of financing.

Services

Standardization

The demand survey revealed that many enterprises buy their standards from NIS or get them for free if they subscribe to the standards services (approximately 70 enterprises). They may also receive the standards from their clients abroad. Sales figures for NIS standards are extremely low (350 to 400 standards sold per year). A standards catalog is published annually with quarterly updates and is available in print and on DVD.

Clearly with this poor demand for standards and few working technical committees NIS cannot support itself without government financing, international projects, or other services.

The main problem for Armenian exporting clients is the parallel existence of the GOST standards, which will continue to be required in the future by partners in the Commonwealth of Independent States, and the ISO and IEC standards, which rule in most other countries. This duplication will exist for some time; however, it hampers development insofar as the approach between the systems is different: the GOST standards continue the Soviet heritage (that is, standards are obligatory), but the ISO and IEC standards have a voluntary character.

TBT Inquiry Point

NIS observes the functions of the TBT notification authority and TBT inquiry point. Since Armenia's accession to the WTO in 2003, approximately 80 notifications have been carried out. Hence, the TBT inquiry point is seldom used. NIS accepted the TBT Code of Good Practice for the Preparation, Adoption, and Application of Standards on July 22, 2003.

Training Center

The Training Center has a flexible structure. It is directed by one senior specialist and has five freelance trainers, who work on a contractual basis. The topics and fields covered include
- Standardization
- Conformity assessment
- Metrology
- Management systems

Courses are offered at prices varying from 8,000 to 57,000 drams.

The center offers training courses in accordance with the Law on Standardization, from which, according to NIS, the exclusive mandate for training and qualification of government officials and staff members of private agencies in the area of the quality infrastructure derives. Participants receive certificates with a validity of three years. If the qualification is not approved, then the persons are not authorized to carry out their work as experts in certification within their agencies. Therefore, the Training Center has a monopoly position, which opens the possibility that it can influence which persons can or cannot work in the certification field. The Training Center is not accredited as a personnel certification body.

Currently, the Training Center offers a more traditional "frontal learning" scheme. What is needed is a practice-oriented "learning-by-doing" scheme. For this purpose, a qualified instructor is needed with concrete knowledge about the implementation of quality management systems (QMSs) and, in particular, of standard ISO/IEC 17011:2004. This instructor should be able to transmit the whole panorama, which is linked not only to the requirements of the development of each different accreditation procedure, but also to the fulfillment of the requirements of corresponding international standards. At the moment, this person can only be a foreign expert.

Conformity Assessment Certificates

The most important source of income for NIS seems to be product certification and the testing laboratory, which is linked to the certification service. For a long time, this certification service was, together with the testing laboratory, the only one existing in Armenia, and even now some enterprises consider it the "national certification body," which is incorrect. Several national, private certification bodies operate in Armenia, but their capacity is said to be small, and their access to adequate laboratory facilities is limited. NIS therefore claims still to have more than two-thirds of the total product certification volume. Some complaints from the private sector claim that the testing and certification process is not transparent enough, the technical competence is doubtful, and the process is subject to corruption. Some entrepreneurs are of the opinion that more private certification bodies and testing laboratories are needed to end the quasi-monopoly of the NIS's certification body.

The study observed that the laboratory is well equipped (financed by the World Bank) and some (not all) staff members are qualified. But little testing work was observed.

Certificates issued by the NIS's certification body are signed by the specialist who conducted the expertise (an NIS staff member) and the director of NIS. This practice is not exactly consistent with international best practices and European rules, which foresee—at a

minimum—clear firewalls between the standardization management and the certification management but prefer a clear separation of the national standardization institute and the certification body.

International Cooperation

NIS (as SARM) is a member of ISO (but not of IEC), and as such it currently has 33 participating and observer memberships in ISO technical committees and subcommittees. For NIS to really and actively make use of and benefit from these committee memberships, however, it would have to be supported by a comparable number of active national "mirror" committees. With only six national committees formally established, there is reason to assume that NIS's ISO committee memberships are primarily formalities.

NIS is also an affiliate member of CEN, but not of CENELEC.

4.3.   The National Accreditation Body

General Observations

Accreditation is a procedure in which an authorized body (the accreditation body) grants formal recognition of a competent body or person to carry out special tasks. The international standards ISO/IEC 17000 and 17011 define accreditation as an assessment by a third party that a CAB has the competence to conduct specified conformity evaluations. The following bodies can apply for accreditation:

- Calibration laboratories(ISO 17025)
- Testing laboratories (ISO 17025)
- Certification bodies for QMSs (ISO 17021)
- Certification bodies for persons (ISO 17024)
- Inspection bodies (ISO 17020).

The essential principles of the activities of a national accreditation body are
- Political independence
- Technical competence
- Confidence
- Access
- Impartiality

Accreditation bodies are relatively new institutions. They should be independent from the NMIs and the standardization bodies. But they need the technical competence of the NMIs, specifically so that they can approve competency in measurements and accomplishment of measurement standards.

ISO/IEC 17011:2004 defines the organizational principles and working procedures that an accreditation body has to fulfill. They form the basis for the mutual recognition agreement or multilateral recognition arrangement that two leading international organizations, the International Laboratory Accreditation Cooperation (ILAC) and International Accreditation Forum (IAF), have developed. Once approved by a peer review of ILAC, IAF, or the regional accreditation organizations, the national accreditation body can sign the mutual recognition agreement for the defined scope (calibration, testing laboratories, QMSs, persons, inspections), and the respective accreditations are internationally recognized. Preparing for international recognition by a peer reviewer is a long-term process because

- The organization and structure of the national accreditation body has to conform with the principles.
- The staff of the accreditation body has to be trained in the relevant ISO/IEC norms and ILAC and IAF guides, needs practical experience, and has to prove its competence in a normal accreditation procedure.

International recognition is given for a determined scope and will be audited within a defined period. International recognition can be withdrawn if the auditors find inconsistency with the respective standards. The accreditation process is very expansive and must be repeated after a certain period. The importance of international recognition cannot be underestimated.

The Legal and Institutional Situation

Some aspects of the current law on accreditation from 2004 and the draft of the new law generate conflicts of interest within the national quality infrastructure and do not correspond to either the internationally harmonized terminology or international guidelines and best practices. Such aspects include portions of the ISO/IEC standards—especially the policy and guides established by ILAC and IAF for implementing the ISO standards.

The national accreditation body, the Accreditation Agency, has the status of a department within the MoE, which is clearly in opposition to the requirement of political independence of a national accreditation body. Nine of the 15 members of the Accreditation Council (60 percent) are representatives of government bodies, and 4 of the 6 representatives of the

private sector, including nongovernmental organizations, have an optional status. Certificates are signed by the minister of economy; hence, laboratories are in a certain manner right when they declare that they were accredited by the MoE.

A QMS corresponding to the requirements of ISO/IEC 17011:2004 is not implemented. This standard clarifies that the structure and operation of the accreditation body must give confidence in its accreditations.

Personnel

An analysis of the resources and technical capacity of personnel of the national accreditation body reveals the following:

− Although the law makes the national accreditation body responsible for applying the standards of the ISO/IEC 17000 series, most of its staff members have not received the necessary systematic training on those standards. The last training occurred in 2001 in Russia, and the last comprehensive training took place in 1996, when the ISO/IEC 17000 series and other relevant standards and guides did not exist.

− The qualification process, which is obligatory for governmental officials and personnel of the private bodies, is provided by the NIS Training and Qualification Center. It is an essentially theoretical "training" process.

− Lack of knowledge of the relevant standards is not limited to the staff of the Accreditation Agency. It is doubtful that most members of the Accreditation Council possess the knowledge to implement a transparent, impartial, and confidential accreditation process.

− All staff members can communicate in Armenian and Russian, but only two are fluent in English, a situation that hinders communication with international organizations. It also prevents understanding of international standards and their application in Armenia, which is essential for the accreditation process and international recognition of certificates of accreditation.

The average staff age of 40.6 years (see table V.7) shows that the age structure of the national accreditation body is not bad. With seven members, it is not oversized, unlike the case in some comparable countries.

Table V.7: Age Structure of the National Accreditation Body Staff

Age	Number of staff members
20–30 years	2
30–50 years	3
50–60 years	1
More than 60 years	1

Source: Accreditation Agency.

The Accreditation Process

The accreditation process and the composition of the Accreditation Council do not correspond to international standards. The process more closely resembles a state licensing process than an accreditation procedure. The following aspects should be mentioned here:

1. There is no documentation of the different processes, the assessors, their skills and experiences, and so forth, as required by ISO/IEC 17011:2004.
2. It is unclear how members of the committee are chosen.
3. There are no established criteria that enable the Accreditation Council to set time limits in which a CAB will be accredited. Different validity periods are applied for the certificate of accreditation.
4. The two technical experts for the evaluation process are nominated and paid by the applicant, provoking a clear conflict of interests.
5. The printing and the recording of the certificates by NIS is against the norms (only the national accreditation body can archive the respective documents). The relationship with NIS has to be restructured.

At the moment, the national accreditation body accredits only testing laboratories and certification bodies. Accreditation of certifiers of food products is obligatory. Certificates have validity only in Armenia because they do not provide the elements required by international organizations—specifically by ILAC.

In at least one case, the national accreditation body fulfilled tasks that do not correspond to its obligations. The Accreditation Agency reviewed whether the documentation of the technical regulations corresponded to the requirements, which is not typically in the mandate of an accreditation body. A national accreditation body's competence is generally limited to confirming the technical capacity of testing and calibration laboratories, certifying bodies, and inspection bodies. The MoE rectified this deviation in October 2009.

The Relationship with NIM and NIS

The weakness of NIM is also an impediment for the development of the accreditation. NIM can only verify, not calibrate, measurement instruments. Hence, the traceability chain cannot be ensured and measurement uncertainty cannot be defined. In some cases, stickers were found on measurement instruments without any documentation. Without strengthening NIM and its use of international measurement standards and procedures, Armenia's accreditation certificates cannot be recognized outside the country.

At least two inconsistencies in the relationship with NIS could be identified:
- The printing and recording of accreditation certificates by NIS.
- The authorization of all government officials and private staff members of CABs (including the national accreditation body) by the NIS Training Center, which is not accredited as personnel certification body.

International Cooperation

The national accreditation body's contact with the international organizations of accreditation—ILAC, IAF, the European Cooperation for Accreditation, and the Asia Pacific Laboratory Accreditation Cooperation) is sporadic and unsystematic. Current and future trends in the development of the international accreditation systems cannot be followed. Intensifying these relations, which would require stronger English-language skills, would improve the Armenian accreditation system.

Overall Assessment of Accreditation

Accreditation is one of the weakest points in the Armenian quality infrastructure. The situation can be summarized as follows:
- The accreditation process does not correspond to international standards and practices (structure, procedures, record, and so forth).
- Personnel are not prepared for a process that leads to international recognition (last training principally in 1996/97).
- Certificates do not comply with the international requirements (ISO/IEC standards and guides and ILAC and IAF documents).
- Certificates are not recognized abroad.
- Accreditation is offered only for testing laboratories and certification bodies.

This weak position could be an advantage if it leads to construction of a scheme according to the reference standards and guidelines issued by the international agencies. Meetings and discussions show that awareness of the need for change is increasing among public officials and experts working on the national quality infrastructure.

4.4. Technical Regulations

Until 2008, NIS was officially responsible for the elaboration of technical regulations (TRs). Since then, the line ministries (Ministries of Health, Urban Development, Agriculture, Nature Protection, and so forth) have developed TRs, but responsibility for supervision and control rest with the MoE. Until October 2009, the national accreditation body performed this work. Since then the Division of Innovation, Metrology, and Standardization has become responsible. Because of the poor quality of the proposed regulations and reform attempts, the minister of economy temporarily halted the work.

NIS has published a list of existing national TRs on its Web site. Judging from the titles, one would assume that many TRs are based on European Union (EU) directives, mostly New Approach directives. NIS management has the following to say about the degree of equivalence between these TRs to their European sources:

- The TRs are "somehow based on EU directives, but are not followed 100 percent for lack of technical capacity."
- The requirements contained in the EU directives are often "graded" or adopted by means of different TRs for different levels of strictness, which may exist in parallel or be introduced subsequently during a transition phase.
- References to standards are always exclusive; the mechanism of self-declaration of compliance (module A) is not used. The standards used can be either "our own standards" or European standards.

Enforcement of TRs is in the hands of various state inspectorates and similar agencies, which are under the responsibility of different ministries:

- Ministry of Economy
  - State Inspectorate for Market Surveillance and Consumer Rights Protection: compliance of nonagricultural products with TRs
- Local government authorities: shelf life of products
- Ministry of Agriculture
  - State Veterinary Inspectorate: raw (unprocessed) meat products
  - State Quarantine and Agrarian Inspectorate: phytosanitary certification

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- State Agricultural Equipment Inspectorate
- Ministry of Health
    - State Hygienic and Antiepidemiology Inspectorate: hygienic conditions of manufacturing, transportation, storage, sales, and services (catering)
    - Pharmaceuticals Inspectorate
- Ministry of Energy
    - Atomic Energy Utilization: nuclear safety and radiation security
- Ministry of Nature Protection
    - State Inspectorate for the Environment
- Ministry of Finance
    - Metal Testing Control Inspectorate
- Ministry of Transport and Communication
    - Transport Inspectorate
- Ministry of Urban Planning
    - State Inspectorate for Urban Planning

Coordination between the different agencies is unclear, as is the relationship to NIM in the case of measurement standards. Visited enterprises claimed that very often only a seal is given, whereas the technical competence is doubtful.

Inspections of food and foodstuffs have recently been organized, and the responsibility is distributed in the following way:
- Ministry of Health: inspection of animal transportation
- Ministry of Agriculture: inspection of foodstuffs from farm to fork.

Some of the surveyed enterprises claim that this division of work makes no sense and produces unnecessary coordination work.

Within the Ministry of Agriculture are two departments that are responsible for its inspections:
- Department for the Border Control of Veterinarian Services
- Department for Control of Agricultural Raw Materials, Medications, and Feed

Veterinary laboratory analyses are performed by the Antiepizootic and Diagnostic Center, which is organized as a closed state stock company and whose laboratories were in reconstruction under the wings of the Food and Agriculture Organization when the study was done.

In this context, it must be recalled that inspections of foodstuffs were canceled in May 2009.

Other important agencies with responsibilities for enforcing nonfood TRs are
- National Center for Technical Safety (Ministry of Emergency Situations, responsible for lifts, pressure vessels, and so forth)
- National Center for Labor Inspection (workplace safety)

The International Finance Corporation is carrying out a project that will help Armenia orient its TRs and the work of its inspectorates on international best practices.

4.5.   The State Inspectorate for Market Surveillance and Consumer Rights Protection

The State Inspectorate for Market Surveillance and Consumer Rights Protection under the MoE is currently working on the basis of the following laws:
- Law on Conformity Assessment
- Law on Metrological Control
- Law on Consumer Rights Protection
- Law on Inspections
- Law on Administrative Offenses.

Its work is a mixture of legal metrology, inspection, and some aspects of consumer protection. It is responsible only for the nonfood sector. In theory, its scope of activities in this sector is huge. However, in practice, market surveillance of consumer and industrial products is close to nonexistent, given the lack of technical capacities (in laboratories) and qualified human resources. For this reason, the inspectorate concentrates on high-risk areas and products. As a consequence, for instance, the market for electrical products falling under the TR on low-voltage products remains largely unmonitored and controlled.

A new legal package is, however, under preparation. The new legislation is supposed to introduce an EU type of market surveillance (postmarket monitoring and control). For this new surveillance to be effective, large-scale awareness, education, and training programs will be required. Currently, there is an immediate need for EU policy and guidance documents on market surveillance to be translated into Armenian.

4.6. Calibration and Testing Laboratories

Currently, in Armenia, only testing laboratories exist. They may be state-owned laboratories, independent private laboratories, and in-house laboratories (belonging to a producing enterprise). Calibration is only theoretically known, not applied (except for international companies that get their traceability from abroad).

Chapter 3 describes the situation of visited testing and research laboratories. The main findings can be summarized as follows:

- Some of the visited (mostly state-owned) laboratories are well equipped (with the support of international donors). However, in most of the laboratories, the equipment is obsolete, and the environmental conditions (air conditioning, humidity control, electricity supply, and so forth) cannot ensure measurements with the desired accuracy.

- The traceability chain is unclear, and in many cases, uncertainty is not estimated. If the instruments are calibrated at all, it is mostly done by the provider without a deeper understanding by the laboratory's staff.

- The better-equipped laboratories seem to be concentrated in the capital.

- Although the interviewed institutions declared a large number of tests, ongoing tests could not be observed in some of the state laboratories. The relationship between the existing dimensions of some of the laboratories and real demand was not made clear. In relation to the size of the country, the real demand of some of the visited state laboratories seemed oversized.

- The staff is not always sufficiently prepared to use the equipment properly.

- Some testing laboratories regretted that manufacturers feel little responsibility for the quality of their products (for instance, construction industry).

- Some of the in-house laboratories have to fight for better conditions to do good work. New independent laboratories need to be built up in a more professional manner, including real demand studies, feasibility studies, and development of business plans. In this context, the international donors also must be aware of their responsibility not to promote white elephants.

4.7. Certification Bodies

Currently, in Armenia only certification of products and QMSs exist. Certification of food products is obligatory, but the food inspections were discontinued in May 2009. According to the national accreditation body, a proposal is being analyzed that would allow the

certification of nonfood products, thereby increasing the demand for product certification bodies.

For many years, NIS was the only certification body. NIS is accredited by the Armenian national accreditation body as
- A product certification body (food and nonfood)
- A systems certification body (quality management and environmental management systems)
- A services certification body (though currently only services related to safety of public food are mandatory)

The demand survey revealed that the following international certification bodies or their national branches are active in the Armenian market:
- Global Certification Limited (GCL)[10]
- SGS
- Bureau Veritas
- Armconsult
- AFNAC AFNOR (a Russian body)

But as the results of the demand inquiry show, implementation of certified QMSs according to ISO 9001 or ISO 14000 does not yet receive the emphasis that it receives in other countries, and the content of those standards does not seem to be completely understood.

Some other private testing laboratories and certification bodies are also accredited by the Accreditation Agency, including MAVAS (food products) and Shinecertificate (construction materials). As previously described, national accreditation certificates are not internationally recognized and are therefore valid only in Armenia.

ECOGLOBE, a national certification and inspection body for organic products, is in the market. It has no national accreditation but is accredited by Deutsches Akkreditierungssystem Prüfwesen, a German accreditation body for bioproducts, and by the U.S. Department of Agriculture; hence, its certifications have international recognition. It uses the trademark "Green Caucasus."

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[10] GCL, also trading as Global Group, is an international accredited certification body with offices in many major cities worldwide. GCL is accredited by the United Kingdom Accreditation Service, and its certificates are internationally recognized.

As different parts of this study demonstrate, the main problems of conformity assessment certificates are

- The accreditation process is not in accordance with ISO/IEC standards and ILAC and IAF guides and recommendations.
- The measurement results of the testing laboratories are doubtful because the traceability chain is undocumented and the uncertainty estimation is not calculated.

The consequence is the nonacceptance of certificates even in cases where an agreement of mutual recognition of certificates exists, such as the agreement between Russia and Armenia. Russian importers require the test to be repeated in Russia. Because the certification of food products in Armenia is obligatory, Armenian exporters must pay for certification twice.

4.8. Technological Development and Innovation

Several laboratories of research and development institutes were visited. Some general impressions follow:

- The laboratories are well organized, but in many cases the equipment is obsolete.
- The personnel are qualified and motivated, but they have problems comparable to those of the testing laboratories: the traceability chain is unclear and, specifically, uncertainty is not calculated, which influences negatively the comparability of the measurement results. The leading personnel are aware of the problem and see the need to develop measurement methods and standards in accordance with international standards.
- Some research laboratories lack younger staff members because of public sector salaries and poor career development perspectives.
- Environmental conditions (air conditioning, humidity, and so on) do not correspond to international standards, and substantial investments are needed if the laboratories are to meet international requirements (analog to ISO/IEC 17025).
- NIM can meet basic calibration needs, but international cooperation in more sophisticated fields is necessary.

5. Future Needs for Developing the Quality Infrastructure

Defining future needs for the national quality infrastructure (NQI) requires
- Making a prognosis of development in the next 5 to 10 years that takes into consideration the country's current economic structure and social situation
- Analyzing current international economic relations and trying to define possible trends over the coming years
- Cross-checking the results against current and foreseeable international economic, social, and political development trends
- Cross-checking the results with the evolving international needs for quality infrastructure (QI)
- Trying to determine the resulting requirements for QI development

A complete and comprehensive economic and social development prognosis of Armenia is not possible. This chapter will attempt to describe some trends and to derive from them and from some international tendencies the future needs for the development of NQI in Armenia.

5.1. Armenia's Current Economic and Social Development Status

The Republic of Armenia is a small, landlocked country with high transportation costs. Its area is 29,800 square kilometers, and its population is 3.2 million. More than 7 million Armenians live in the diaspora, mainly in France, the Russian Federation, and the United States. Armenia has open frontiers with the Islamic Republic of Iran and Georgia, whereas the frontiers with Azerbaijan and Turkey are closed. These general conditions influence the country's development.

In 1988, Armenia was hit by a severe earthquake that damaged one of the most industrial regions of the country. In 1991, the Republic of Armenia was created during the dissolution of the Soviet Union. As a consequence of these events, not only were traditional economic cycles and industrial production interrupted, but also other economic sectors in Armenia declined. Industrial sectors such as the space industry, which had a well-developed research and development base, and the production of watches did not find buyers outside the country and were virtually closed down. Agricultural production decreased and was partially transformed into a kind of subsistence economy. In contrast, the informal sector grew. The decline of the national economy was so deep that 1990 levels were reached again only in 2004, despite the beginning of growth in 1994. Other negative factors for economic development were the conflict with Azerbaijan and internal political disturbances.

Table VI.1:   Economic Structure and Economic Growth in Armenia

		2001	2007	2008	2001-2007	2008	2009 Q1
		Structure of Nominal GDP, %			Growth Rate, %		
	Main Branches	**79.5**	**77.0**	**75.8**	**12.5**	**5.6**	**-4.3**
F	Construction	9.7	24.5	26.9	26.7	7.2	-20.5
A	Agriculture, hunting and forestry	25.6	18.2	15.8	8.0	1.3	-5.1
G	Trade, repair of motor vehicles, household and personal goods	10.6	10.9	11.0	13.6	7.9	1.9
D	Manufacturing	15.7	9.4	8.3	7.1	0.6	-8.8
I	Transport and communication	7.0	6.9	6.7	13.1	9.4	0.9
K	Real estate, renting and business activities	4.3	3.8	4.1	13.0	13.1	15.4
E	Electricity, gas and water supply	6.7	3.3	3.0	0.1	8.0	-10.6
	Other Branches	**12.2**	**14.4**	**14.8**	**11.3**	**7.6**	**-3.1**
M	Education	3.3	2.8	2.8	8.5	-0.2	3.8
N	Health and social work	1.3	2.5	2.6	17.2	0.4	-1.3
L	Public Administration	3.0	2.5	2.6	12.6	10.6	5.2
J	Financial intermediation	1.9	2.5	3.1	16.4	23.5	-21.9
C	Mining and quarrying	0.8	2.3	1.8	10.1	1.5	-11.4
O	Community, social and personal service	1.5	1.3	1.4	6.9	10.1	26.2
H	Hotels and restaurants	0.4	0.4	0.4	14.7	12.7	12.7
B	Fishing	0.0	0.0	0.1	24.8	20.9	4.4
P	Private households with employed persons	0.0	0.0	0.0	8.5	10.7	14.4
	FISIM	**-1.4**	**-1.4**	**-1.7**	**7.4**	**22.8**	**0.6**
	Net taxes on products	**9.7**	**10.0**	**11.1**	**14.1**	**16.7**	**-15.8**
	GDP	**100**	**100**	**100**	**12.6**	**6.8**	**-6.1**

Source: Ministry of Economy, *Armenia Economic Report 2009: From Crisis toward New Development* (Yerevan: Ministry of Economy of the Republic of Armenia, 2009), 17–18.

The change in the economic structure can be seen in table VI.1 from the sharp decline in agriculture and manufacturing and the significant growth in construction (interrupted by the real estate and financial crisis of 2008/09), with some growth of mining and fishing.

**Figure VI.1:   Main Industrial Sectors of the Armenian Economy**
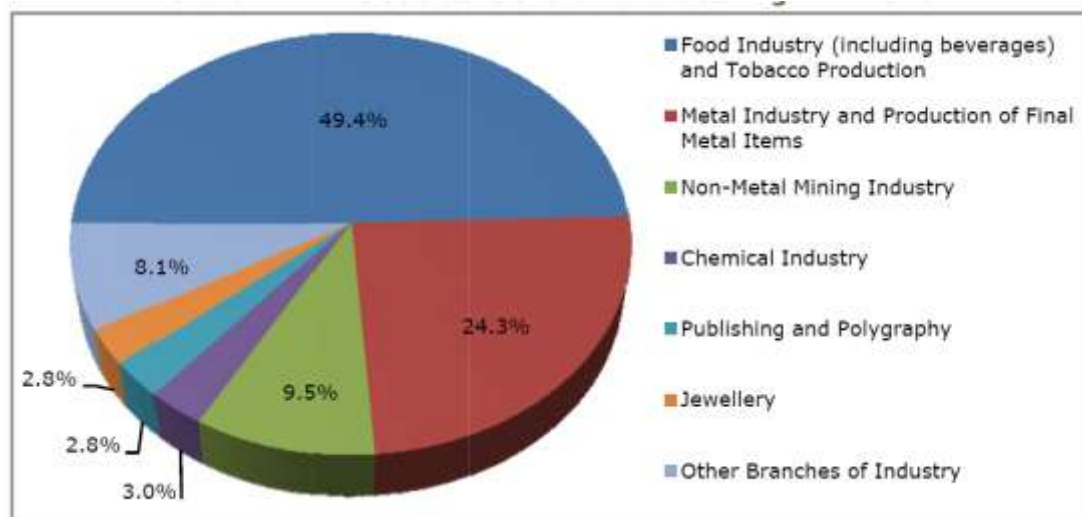
Also of interest is the current structure of the manufacturing industry (see figure VI.1). The food industry (including beverages and tobacco) accounts for about 50 percent of industrial production, the metal industry and production of finished metal items for about a quarter, the nonferrous mining industry for nearly 10 percent, and the chemical industry for 3 percent. The main types of metals extracted are copper (70 percent), molybdenum (15 percent), zinc, and gold. Between 2000 and 2008, most foreign direct investment was directed toward developing the transport and communication sector, nonferrous metal industry, mining industry, food industry, and construction and service sectors. Striking, too, is the role of jewelry, which played a large role in imports and exports until the 2008 crisis. Armenian enterprises polish diamonds imported from Belgium and also export to Belgium (see tables VI.2 and VI.3).

An international comparison (figure VI.2) shows the relatively high participation of construction and agriculture in the structure of value-added production (together contributing more than 40 percent of gross national product) and the underrepresentation of manufacturing.

Figure VI.2:   International Comparisons of Components of Value-Added Production
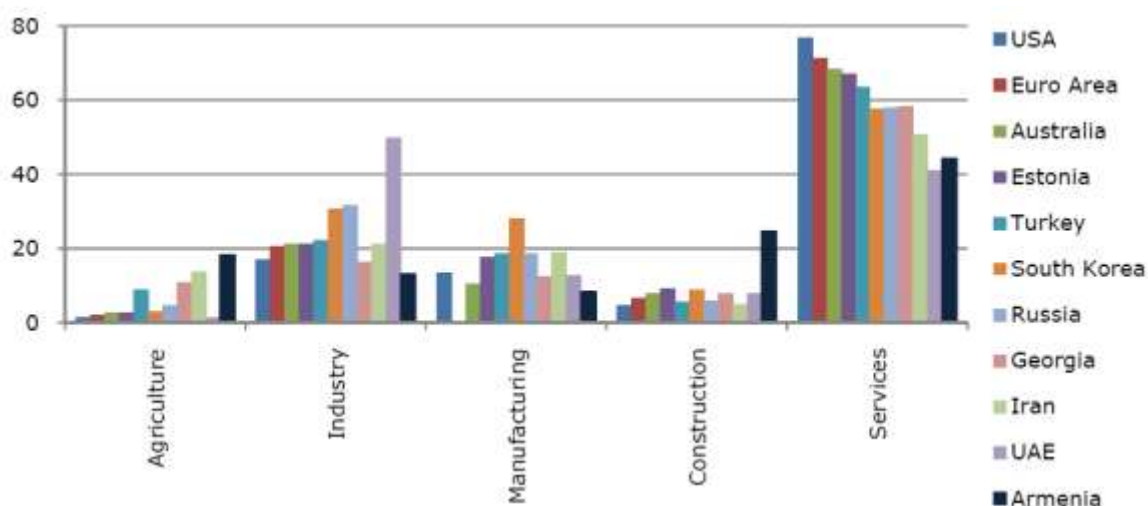
5.2.   International Economic Relations and the Economic Competitiveness of Armenia

Since its foundation, the country has confronted the need to reorient its internal economic structure, adapt it to national requirements, and insert it into international economic relations. This situation is reflected up to a certain point in table VI.1, but it is more visible if export development is considered (tables VI.2 and VI.3). The percentage of various components in the export structure differ a bit from the economic structure and the structure of the manufacturing industry but essentially correspond (table VI.2). The main export products are:

- Metal and metal products (32.8 percent)
- Foodstuffs, beverages, and tobacco (18.9 percent)
- Precious stones and metals (16.4 percent)
- Mining products, fuel, and energy products

Table VI.2:   Structure of Armenian Exports, 2008

	Number		Volume	
	Items	Structure, %	mln USD	Structure, %
I. Food, Agricultural Product, alcoholic and non alcoholic beverages, tobacco and row materials	92	14.3	201	18.9
II. Mining Products, fuel and energy products	19	2.9	171	16.2
III. Chemical products, rubber	108	16.7	35	3.3
IV. Fur, Leather products made thereof	11	1.7	3	0.3
V. Wood and Paper Products	33	5.1	5	0.5
VI. Textile, shoes	93	14.4	42	3.9
VII. Products made of stone, ceramics, glass, gypsum	27	4.2	14	1.3
VIII. Precious stones, metals	12	1.9	174	16.4
IX. Metal and products made thereof	65	10.1	347	32.8
X. Vehicles, equipment, transportation means	127	19.7	47	4.4
XI. Other Commodities	58	9.0	20	1.9
Total	645	100.0	1060	100.0

Source: Ministry of Economy of the Republic of Armenia, *Armenia Economic Report 2009: From Crisis toward New Development* (Yerevan: Ministry of Economy of the Republic of Armenia, 2009), 39.

The official figures show that during recent years the geographic distribution of exports has changed decisively: the participation of Commonwealth of Independent States (CIS) countries in Armenian exports decreased from 81 percent in 1993 to 31.3 percent in 2009 (see table VI.3). In particular, countries such as Belgium, Germany, and the United States have gained an important role. In this context, however, one must remember that a big part

of the exports to non-CIS countries is metals and metal products (Germany)[11] and jewelry (Belgium) rather than final manufactured products. New, important export partners are the Arab countries, the Islamic Republic of Iran, and neighboring Georgia. Nevertheless, the CIS countries (70 percent) and particularly Russia (65 percent of the food exports to CIS countries) still play a significant role, specifically in food and other manufactured products.

This duality influences quality requirements, which are principally divided in two sections:
- One is defined by World Trade Organization rules.
- A second is ruled by the EuroAsian Interstate Council, the Interstate Council for Standardization, Metrology, and Certification of the CIS, where the old GOST standards (originally developed by the government of the Soviet Union as part of its national standardization strategy) are still dominant.

The first-line quality requirements for final manufactured products in Armenia are for the domestic market and the CIS countries. The pressure to produce in conformity with international conformity assessment procedures and standards is not yet high.

The production of electrical energy is an important economic sector: 43 percent of electric power is produced by the nuclear power station, 31 percent by the hydroelectric power plant, and 27 percent by heat electro-power stations. Since 1997, Armenia has been exporting about 10 percent of its electric power production to neighboring countries (mainly Georgia and the Islamic Republic of Iran); in 2004/05, such exports reached about 17.5 percent. Plans exist to integrate Armenia into the European energy transmission system, but the voltage of the transmission lines would need to be changed from 380 kilovolts to 400 kilovolts. What is planned (with help from the German Bank for Reconstruction and other organizations) is a network that unifies Armenia, Azerbaijan, the Islamic Republic of Iran, Georgia, Russia, and Turkey.

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[11] The German processor of noble scrap, CRONIMET Mining GmbH (headquartered in Karlsruhe), became the most important employer in Georgia with its majority participation in Armenian Molibden Production LLC (3,000 employees).

Table VI.3:   Armenian Exports, by Country

	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008
Exports	156.2	215.5	270.9	290.3	232.5	220.5	231.7	300.5	341.8	505.2	685.6	722.9	973.9	985.1	1,152.3	1,057.2
CIS countries	126.6	157.9	169.6	133.7*	94.7	80.5	56.4	73.4	89.1	96.3	129.1	125.1	187.9	212.5	355.3	331.1
Russia	58.5	83.9	90.8	96.1	62.9	40.0	33.9	44.6	60.5	64.6	94.4	77.9	119.0	121.2	201.5	208.2
Turkmenistan	57.0	65.6	68.7	17.5	13.8	22.7	6.1	5.5	0.8	2.8	3.6	0.6	1.0	1.8	2.5	4.5
Georgia	3.2	2.9	2.7	6.9	10.7	9.6	11.1	16.0	12.4	16.6	18.7	29.1	46.8	54.6	87.9	81.8
Other countries	8.0	5.4	7.4	7.6	7.3	8.3	5.3	7.3	15.3	12.3	12.4	17.5	21.0	34.9	63.4	36.6
Non CIS countries	29.6	57.6	101.3	156.6	137.8	140.0	175.3	227.1	252.8	408.8	556.5	597.8	786.1	772.6	797.0	726.1
Belgium	14.9	26.0	30.8	14.7	47.0	49.8	84.2	75.1	46.5	92.3	123.8	107.9	124.6	108.8	100.2	89.6
Iran	5.5	14.6	35.0	43.9	42.6	31.4	34.2	30.1	31.9	31.5	22.5	30.6	28.5	29.6	38.5	25.1
USA	0.2	0.4	0.6	4.4	7.1	11.6	16.0	37.9	52.3	46.2	56.1	70.6	62.2	65.1	51.4	52.8
Germany	0.3	6.6	10.1	3.7	9.3	9.3	10.2	12.9	11.1	28.2	44.4	83.2	152.1	148.0	169.7	183.7
Great Britain	0.0	0.5	1.3	3.2	1.2	8.1	9.4	10.1	20.1	51.1	42.6	1.2	0.4	7.6	2.8	40.8
Turkey	0.3	0.2	2.6	6.0	7.2	3.0	1.1	1.5	1.1	1.4	1.2	2.0	2.5	2.4	3.0	1.9
Other countries	8.4	9.5	20.9	80.6	23.6	26.8	20.1	59.6	89.8	158.2	265.9	302.3	415.7	411.1	431.3	332.3

Source: Ministry of Economy of the Republic of Armenia, *Armenia Economic Report 2009: From Crisis toward New Development* (Yerevan: Ministry of Economy of the Republic of Armenia, 2009), 111.

Another important point is that, to date, Armenia has been a very closed economy. The foreign trade turnover to GDP ratio is among the lowest of the countries considered in figure VI.3. It is comparable with such larger countries as the Islamic Republic of Iran, Russia, or Turkey, all of which have a relatively big domestic market. Typically, smaller countries (for instance, Belgium or Hungary) benefit from a much higher foreign trade to GDP ratio.

A very important factor for the future economic and social development of Armenia is the country's degree of competitiveness. The World Economic Forum has developed a comparison based on the most important indicators (see figure VI.4). The bar graphs show that in most areas Armenia performs worse than the CIS and European Union (EU) states. What is really concerning, however, is the evaluation of the technological readiness of the country for market competition. In this context, the metrological and standardization base plays an important role. For a landlocked country intending to develop a knowledge-based economy, reaching technological readiness is a real challenge that needs a clear vision, a well-developed implementation strategy, and private and public investments.

Figure VI.3:   Indicators of Openness for 2007 (percent)
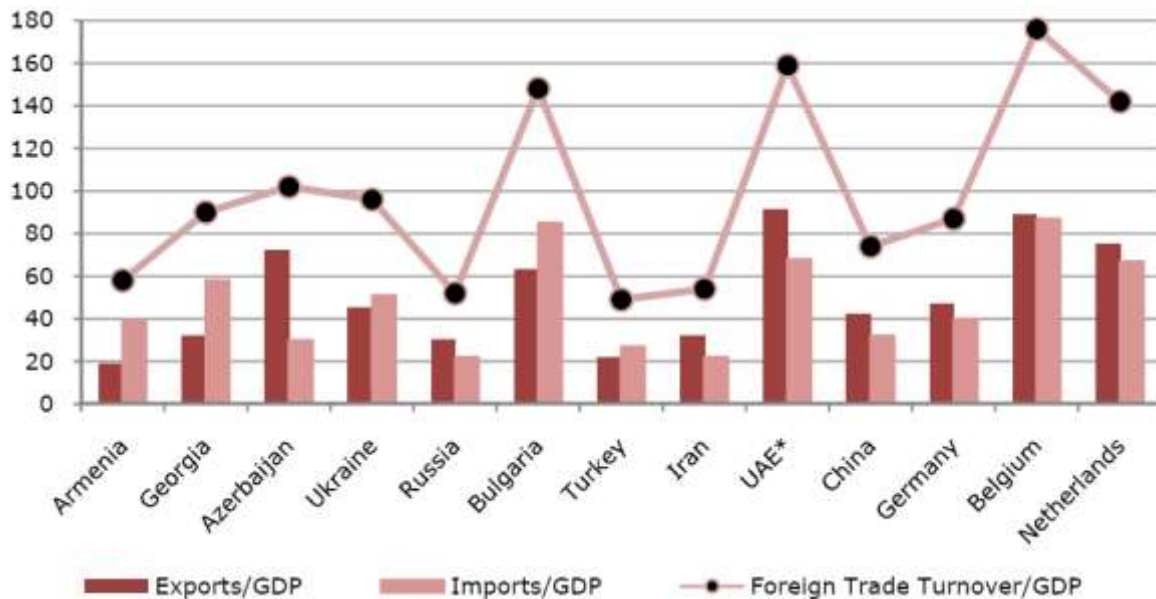
Source: Ministry of Economy of the Republic of Armenia, *Armenia Economic Report 2009: From Crisis toward New Development* (Yerevan: Ministry of Economy of the Republic of Armenia, 2009), 35.

Figure VI.4:   Competitiveness of Armenia and CIS, Eastern European and European Union Countries
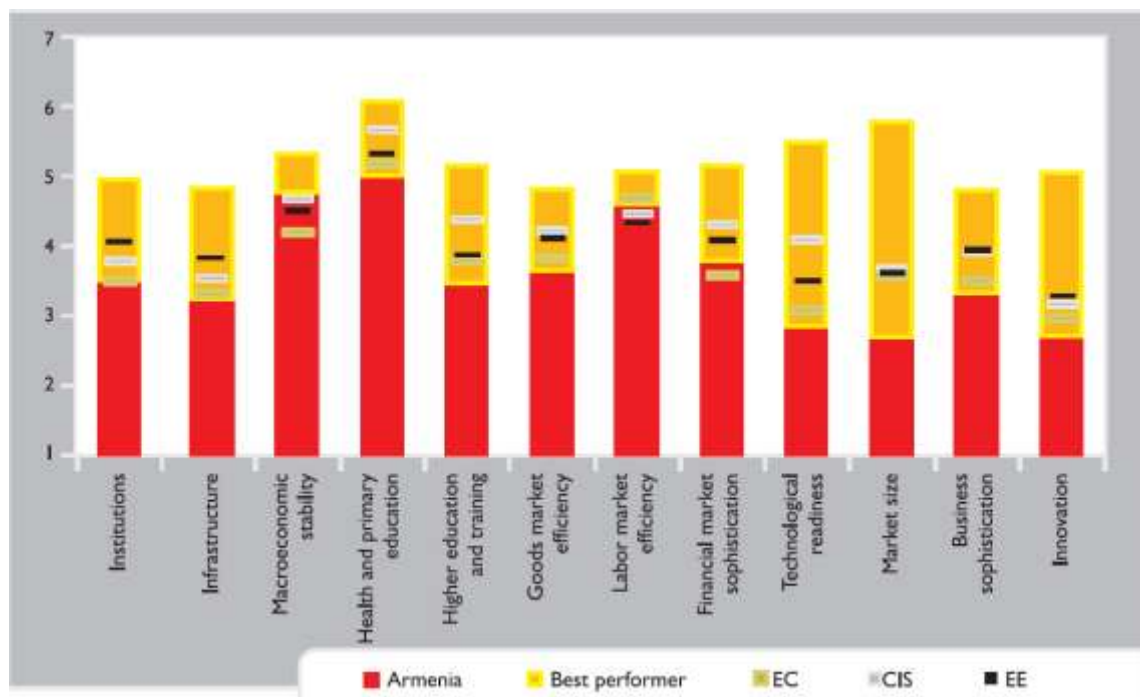
Source: World Economic Forum 2008.

Unsurprisingly, the export structure of Armenia reflects the competitive situation of the country. Most exports are concentrated in industries that compete on price and in low-quality market segments. As a landlocked country, Armenia is subject to transportation cost disadvantages that can be compensated for only by moving to higher-value products and services.[12] Figure VI.5 illustrates how only a small share of exports from Armenia to the EU comes from industries where quality plays an important role. Countries in the upper triangle export more in sectors where quality defines the competitive edge (that is, where firms can increase the value of their exports by upgrading to higher-quality market segments within the same sector). Armenia finds itself in the bottom triangle, where exports are dominated by price competition, with few opportunities for enhancing market value through quality improvements, but where fierce competition exists with other low-cost countries, a number of which provide subsidies for production or transportation. For Armenia, competing on quality instead of price could lead to a more sustainable competitive advantage.

Figure VI.5:   Share of Armenia's Exports in Industries Competitive on Quality, 2006
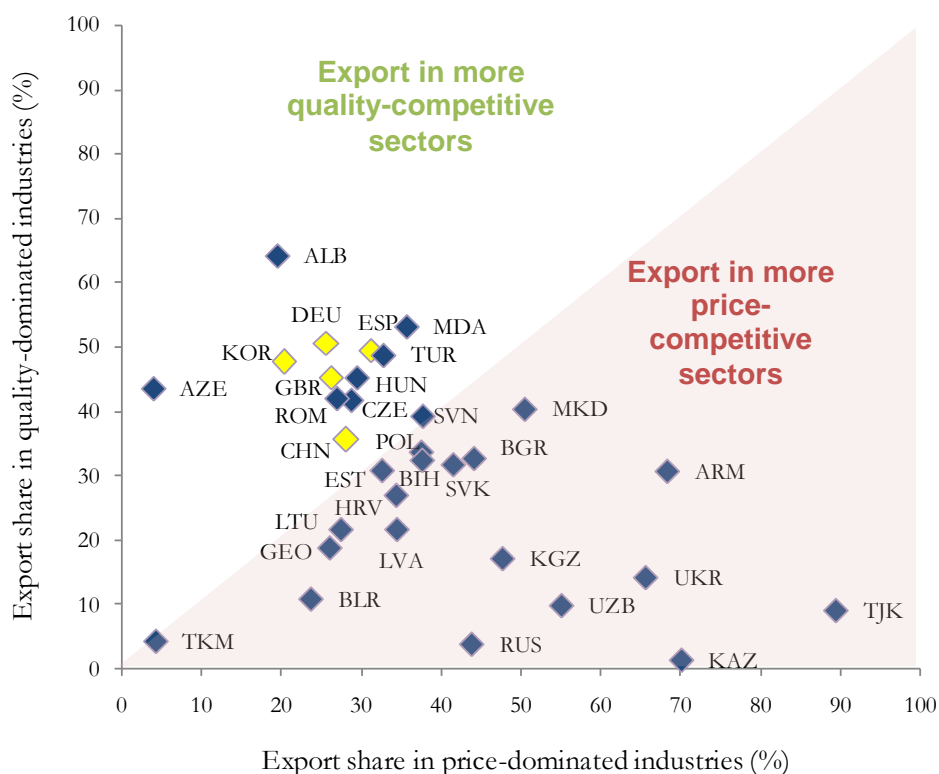
Source: Racine, J.L (2011) *Harnessing Quality for Global Competitiveness*, World Bank: Washington D.C.

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[12] Hergnyan, Manuk, Gagik Gabrielyan, and Anna Makaryan, *National Competitiveness Report: Armenia* (Yerevan: Economy and Values Research Centre, 2008).

Making a prognosis for economic development in the coming years is extremely difficult. The tendencies can be described as follows:

- Currently, Armenia has some importance as a *producer of some rare and precious metals*. Although export income saw a sharp decline in 2008/09, this economic sector will certainly have a role to play in the future.

- At the moment, the *manufacturing industry* appears weakly developed, but in the future some niche product growth can be expected. This growth could be in agricultural and fish products, such as meat and meat products, fish and crabs (partially from aquaculture), or canned fruit, fish, and vegetables. Also alcoholic and nonalcoholic beverages (especially mineral water, juice, and brandy) seem to have a future. International organizations are supporting some serious efforts to develop certified bioproducts ("Green Caucasus") using the absence of pesticides, chemical fertilizers, and other chemical substances in agricultural production as a competitive advantage. However, according to recent evidence, agricultural products—especially those from the mining districts—have relatively high heavy metal content. Conformity assessment and the implementation of basic principles of food safety will be required.

- Armenia has had a tradition of *footwear and apparel production* that may be revived, but more on a subcontracting and a boutique basis. The *chemical industry* and *cosmetics* are also possible areas to explore. What is important for Armenia as a landlocked, small country with difficult transport connections is to add more value to its export products.

- Given its geopolitical context, the Armenian government has developed a plan to make the *knowledge and innovation* fields the economic basis of Armenia's competitiveness.[13] In Soviet times, Armenia had some experience with the space and nuclear industry, and more recently, its information technology industry has experienced a small boom; however, during the 2008/09 crisis, some of these enterprises closed. The existing spectrum of companies seems to be very large, and from the more than 200 enterprises existing in the ICT sector only 7 are certified by the respective International Organization for Standardization (ISO) norms. Possibilities for the future also mentioned by the Government are nuclear medicine. An isolated solution is not sustainable in the long run, however. One of the main bottlenecks is the missing basic QI.

- Although *construction* suffered a decline, it will play an important role in the future. The main engine of growth will be the establishment of a better road infrastructure, including some new highways that improve connections with neighboring countries, such as the Islamic Republic of Iran and Georgia. If the consensus process with Turkey advances, new highways to that border can also be expected. Even if the boom of

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[13] Mitra, Saumya, Douglas Andrew, Gohar Gyulumyan, Paul Holden, Bart Kaminski, Yevgeny Kuznetsov, Ekaterine Vashakmadze. 2007. *The Caucasian Tiger,* Washington, DC: World Bank, 117ff. and 489ff.

new dwellings and office buildings does not repeat the pre-crisis growth rate, a revival of development can be anticipated. Adoption and application of international construction standards and testing methods will be very important.

- Another economic sector with prospects is the *energy sector*. The government has declared the improvement of energy efficiency as a priority for much new investment. As an exporter of energy, Armenia plans to be included in the European transmission network, which means replacing the old Soviet 380-kilovolt transmission lines with 400-kilovolt lines. Armenia can also play a role in the transport of gas and oil from the Islamic Republic of Iran and, in the future, from Azerbaijan and the Central Asian countries to European consumers. Metering will gain importance in this context. For QI services, this means traceable measurement standards (electricity, gas and oil flow, and natural gas chromatography); harmonization of standards; and accredited testing laboratories and certification bodies.

5.3. National and International Development Trends and Future Needs for National Quality Infrastructure Services

The demand inquiry and the assessment of the existing NQI structure and the NQI services offered show the following:

- Legislation does not correspond to international requirements and best practices.
- The main institutions of NQI exist, but they are not fulfilling their tasks in accordance with international standards and best practices.
- A clear vertical definition of the responsibilities for NQI exists (Ministry of Economy), but a real and efficient inclusion of stakeholders (other public institutions, private economic sector, consumers, and environmental protection groups) is missing.
- To date, its orientation has been more internal (national particularities) rather than global (what can be taken from international experience and applied in Armenia).
- In practice, neither scientific and applied industrial metrology nor accreditation exist.

Thus, the first requirement is to implement a basic NQI structure that meets international requirements and best practices and opens the way to the desired deep and comprehensive free trade agreement with the EU.

At the moment, pressure for development of an adequate NQI derives not so much from the internal market as from the external market. In this context, Armenia has to prepare a legal and institutional framework that corresponds to the EU structure and ensures Armenia's equal participation in international economic relations.

Although currently the main influence seems to be the need to participate in international commercial exchange of products and services, the future needs of NQI development are determined by a complex of diverse factors (see figure VI.6) coming from the national and the international context. The following sections describe some of the most important needs.

Figure VI.6:   National and International Requirements for NQI Development
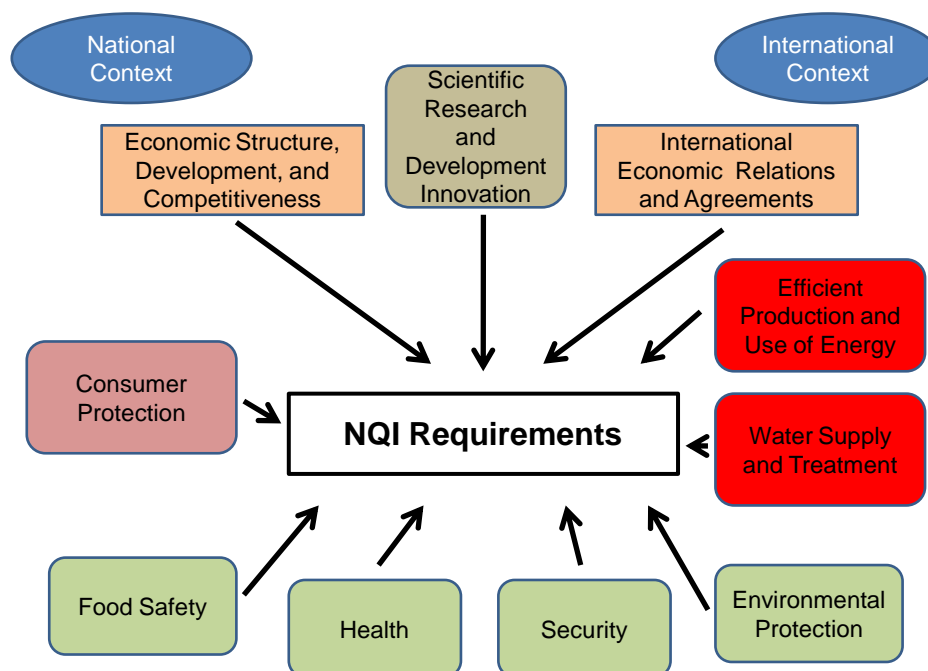
Industry and Trade

Taking into account the analysis of the demand inquiry, the current economic structure, and certain foreseeable trends, the following needs arise from industry and trade:

- *Implementation of basic metrological services (mainly calibration, but also verification and type approval) that ensure the traceability chain for the most used magnitudes.* These magnitudes are mass, flow, temperature, pressure, electrical quantities, relative humidity, length, ionizing radiation for basic chemical quantities such as pH measurement, electrolytic conductivity, and liquid density. In the midterm, sending measurement instruments abroad for calibration is damaging the competitiveness of Armenian small and medium-size enterprises.
- *Strengthening testing laboratories and conformity assessment bodies (product certification).* Product certification is necessary not only for the main export goods, such as

metals, foodstuffs, and beverages, but also for those used domestically (for instance, construction and construction materials). In particular, a documented chain of traceability of measurements must be established, personnel must be qualified, equipment must be improved, and last but not least, quality management systems (QMSs) must be implemented. In some cases, ISO/International Electrotechnical Commission (IEC) 9001 and ISO/IEC 14000 are sufficient, but in some cases accreditation according to ISO/IEC 17025 seems relevant.

- *Harmonization and—if necessary—translation of the international standards.* Harmonization will be increasingly important as use of the old GOST and technical specifications decreases. The National Institute of Standards of Armenia should follow the demand-led needs of industry and other (private and public) stakeholders. Therefore these groups should be actively included in the technical committees.

- *Harmonization of the technical regulations with European rules and directives.* Harmonization should occur in accordance with Armenian priorities—in particular the Measuring Instruments Directive[14] and the Prepackaging Directive.

- *International recognition.* To be competitive on international markets, industry needs accredited testing laboratories and certification bodies whose certificates are internationally recognized. To be accredited, the testing laboratories have to prove their measurement capabilities through proficiency tests. Proficiency test schemes with assigned reference values also contribute to establishing better traceability. The accreditation can be done by foreign accreditation bodies that have signed the International Laboratory Accreditation Cooperation (ILAC) mutual recognition agreement or the International Accreditation Forum (IAF) multilateral recognition arrangement. The national accreditation body can also provide accreditation if it obtains international recognition through a peer review (regional accreditation organization, ILAC, or IAF).

- *Development of QMSs.* Only a few Armenian enterprises have established QMSs. The demand for certified QMSs pursuant to ISO/IEC 9001, ISO/IEC 14000, Hazard Analysis and Critical Control Point (HACCP), or ISO 22000 will increase. Serious clients will look more carefully for certifiers with an international reputation.

- *High-quality services.* Many interviewed enterprises complained about the poor quality of the inputs. The need is increasing for developing high-quality measurement, standardization, testing, and certification services along the production chain.

- *Better translation of documents.* As in other countries, the calibration, testing, certification, and accreditation documents need at least consistent versions in Armenian and English.

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[14] Directive 2004/22/EC of the European Parliament and of the Council of 31 March 2004 on measuring instruments.

Consumer Protection

The current main components of consumer protection are the State Inspectorate for Market Surveillance and Consumers Rights Protection and the three existing consumer protection nongovernmental organizations (NGOs). The inspectorate is less a market surveillance authority than an institution that combines certain functions of legal metrology with inspections for high-risk areas and products. The lack of personnel and technical equipment leads to quite reduced activities. Given the political desire to bring the country into the EU during the next years, the following developments will be necessary:

- Establishing a basic system of legal metrology for the most important items: trade balances, water meters, gas meters, watt-hour meters (meters that measure electrical energy consumption), and flow meters (gasoline and gas-dispensing pumps). This system needs not only trained personnel and technical equipment, but also traceability to the International System of Units by means of national measurement standards maintained by the National Institute of Metrology (NIM).

- Training personnel, establishing awareness measurements for enterprises and state regulatory authorities, and establishing adequate institutions to enforce and to monitor the implementation of EU directives.

- Improving consumer protection through campaigns to sensitize consumers to demand products that meet quality standards. In this context NGOs, state authorities, and the media have to play a more active role.

- Strengthening NGOs and independent testing laboratories so that they can monitor products and services. The main fields will be the consumption of energy, water, gas, and gasoline and food safety.

- Implementing a market surveillance system whose main elements correspond to European rules and practices.

- Requiring reliable labeling on consumer products

Food Safety

With the development of the worldwide trade of foodstuffs, establishing a food safety system from farm to fork is gaining more and more importance. The following trends can be observed:

- *Coordination will increase between the two systems that secure food quality, the Sanitary and Phytosanitary Standards and the Technical Barriers to Trade, because the problems are interlinked and increasing investments require more coordination.* In particular, cooperation is necessary between the QI institutions, the Ministry of Econ-

omy, and the Ministries of Agriculture and Health and their inspectors, the Customs Authority, and other actors in the field.

- *The NIM has to secure the traceability of basic measurements at each stage.* In more sophisticated fields, the level of traceability given by specialized foreign laboratories and institutes has to be expected.

- *Foodstuff testing laboratories and certifiers need to harmonize their quality systems, standards, testing methods, and product certificates to international requirements and best practices.* The importance of documented traceability of measurements and certified reference materials will increase.

- *Food safety requires the implementation of certified QMSs (ISO/IEC 9001, ISO/IEC 14000, ISO/IEC 22000, HACCP, and so forth).* Enterprises in which QMSs should be implemented include those producing bioproducts, which are seen as a possible niche, and those where certification of the production process and products is desirable. In Armenia, many enterprises are not certified. The demand for certification will probably increase with pressure from international traders of the products.

- *The food safety systems recommended by the Codex Alimentarius and the EU directives require rigid control and inspection of the production process and product from the very beginning all along the production chain*. The traceability of the final foodstuff product must be secured. In this context, the development of quality services (measurement, standardization, testing, certification, inspections) along the value chain will gain importance.

- A *change in the business culture of the producers is also necessary.* The process of certification and the certificate itself have to correspond to international standards and practices. If they do not, the documents are unreliable. The existing practice of sometimes buying certification papers without underlying documentation is counterproductive.

Environmental Protection

Scarce natural resources, an increasing amount of waste, climate change, and the deterioration of the environment have provoked increased regulation and implementation of many protective measures that require environmental standards and standardized measurement and testing methods. In Soviet times, environmental protection was not given much priority. Now, however, Armenia has joined a number of international agreements that have to be implemented. People are becoming more and more conscious that pollution puts their quality of life in danger. The following trends can be expected:

- Interest in and demand for measuring water pollution (solid and microbiological), soil pollution, and air pollution will increase. The control of exhaust gases and the mea-

surement of radiation from nuclear plants will also have more importance. Standardized testing and measurement methods are necessary to make the results comparable.

- Harmonization of legislation and standards with those of the EU will be necessary.
- The existing Ministry of Environment laboratories will play a more and more important role. Probably, private laboratories will also enter this area. Increased qualifications for the personnel who apply the new measurement instruments and methods will be necessary. The traceability of the measurements and their reliability have to be secured.
- Laboratories working in this field should have a quality system and be accredited according to ISO/IEC 17025.

Health

Health is a relatively new field that is developing rapidly. New health products and instruments are entering the market. Certified Reference Materials are introduced in clinical chemistry and laboratory medicine. More accurate measurement of cholesterol, blood fat, and other indicators helps improve the effectiveness of medical treatment and saves money. Proficiency tests for clinical and pharmaceutical laboratories support comparison of measurement results and establishment of reliable methods. Many clinical laboratories implemented QMSs to improve the reliability of their results. The following trends can be expected:

- The demand for the implementation of QMSs in clinical and pharmaceutical settings will increase.
- The pressure to improve the accuracy of measurements in clinical tests will increase and create demand for CERTIFIED REFERENCE MATERIALs with a documented traceability chain. This demand can be only partially satisfied by NIM. Membership in networks of international clinical laboratories such as the International Federation of Clinical of Clinical Chemistry and Laboratory Medicine and contacts with the Joint Committee for Traceability in Laboratory Medicine can help improving the situation.

Efficient Production, Distribution, and Use of Energy

Armenia exports energy; it intends to join the European transmission network and to adjust the standards of its transmission lines to the European standards (the current 380-kilovolt lines will be replaced by 400-kilovolt lines). Armenia also has potential as a transit country for oil and gas from the Islamic Republic of Iran and in the future from Azerbaijan and Central Asia. Improving energy efficiency is a declared aim of the Ministry of Energy. In this context,

the requirements for better measurement and adjustment and application of international standards will increase, although at this point the details are unclear. The following tendencies will determine development in this area the coming years:

- The change of the transmission voltage, the continued export of electricity, Armenia's anticipated membership in the European electricity transmission network, and the need for measures for improving energy efficiency will increase the demand for more accurate measurements. Smart grids and other new instruments require more exact and efficient measurements.

- Improving efficiency also means strengthening reliable testing capacities for electrical devices. Here, regional cooperation is needed (for instance, with Georgia for generators and watt-hour meters or with Ukraine for explosion-protected electrical equipment).

- The increasing use of natural gas and the development of Armenia as a transit country (through INOGATE, the Interstate Oil and Gas Transportation to Europe mechanism) require the improvement of the respective measurement capacities for flow and calorific value. Because of the high cost, this problem cannot be resolved by only one country.

- The transport and consumption of oil and fuel also demand more accurate measurements for both industry (calibration) and households (verification).

- Type approval and the verification of gas and gasoline dispensers, gas meters, and watt-hour meters are important to ensure efficient use of energy resources and to protect consumers from deception.

Water Supply and Treatment

Water supply and treatment are important issues not only for households but also for industry and commerce. Control of water quality and prevention of water pollution are important for human, animal, and plant health as well as for efficient use of water resources. For these reasons the demand will increase for

- Reliable and traceable measurement of water consumption
- Improved measurement and testing capacities for solid and microbiological pollution

Research and Development and the Innovation Process

Technological research and development and the innovation process are not possible without laboratories that produce reliable testing and measurement results and standards. Only through testing and standardization can innovation be implemented. Armenia had

important potential for research and development, as well as innovation, in Soviet times, especially in the space industry. Currently, capacities still exist in nuclear physics, information technology, optics, and water (medical effects of mineral water).

- Research and development, as well as innovation, require a solid metrological base with traceable national measurement standards. In many fields, obtaining traceability from laboratories abroad will be necessary (the national metrology institute and calibration laboratories).
- Laboratories need to implement quality systems to make the results of testing and measurement reliable and comparable. In all cases, accreditation according to ISO/IEC 17025 would be helpful in securing international recognition and comparability of testing and measurement results.

5.4. International Cooperation

The need for comparability of standards as well as testing and inspection results and the fact that one country alone cannot resolve all the problems are fostering the emergence and development of international organizations and networks in the field of QI. Increasingly, international organizations such as the Bureau International des Poids et Mesures (BIPM), the Comité International de Poids et Mesures (CIPM), the International Organization of Legal Metrology, ISO, IEC, the International Telecommunication Union, ILAC, and IAF are cooperating with each other in building an international network of QI institutions. The number of agreements of mutual recognition of testing results and certificates based on ISO standards and guides is increasing.

The growing membership of these organizations and networks has led to founding of regional organizations that can better organize the work and react to special conditions in their respective regions. In the field of metrology, examples of such regional organizations are the European Association of National Metrology Institutes (scientific and applied metrology), WELMEC (European Cooperation in Legal Metrology), and the Euro-Asian Cooperation of National Metrological Institutes. In standardization, examples include the European Committee for Standardization, European Committee for Electrotechnical Standardization, and COPANT (Comisión Panamericana de Normas Técnicas, or Pan-American Standards Commission). In accreditation, there is the European Cooperation for Accreditation and the Asia Pacific Laboratory Accreditation Cooperation. For smaller countries in particular, membership in these organization is increasingly important. The new field of metrology in chemistry resulted in new BIPM-CIPM committees, such as the Consultative Committee for Amount of Substance—Metrology in Chemistry or the Joint Committee for Traceability in Laboratory Medicine.

An important issue in recent decades is the emergence of associations of different types of laboratories not only on the national level, but also on the regional and international levels. The activities of these associations are oriented toward improving personnel performance, improving testing methods and instruments, and standardizing testing methods. Well-known laboratory associations in Europe are Eurolab (active in and representing the field of testing and product certification) and Eurachem (active in the field of chemical analyses and chemical measurement, training and workshops, and issuance of many practical guidance documents). In the field of clinical laboratories, one of the main players is the International Federation of Clinical Chemistry and Laboratory Medicine.

6. Conclusions and Recommendations

6.1.   Summary of Findings

An effective and internationally harmonized national quality infrastructure (NQI) can contribute to Armenia's global competitiveness by improving the quality and safety of domestic products and services and by supporting the country's greater trade integration with the European Union (EU) through lower technical barriers to trade. The term *national quality infrastructure* denotes the complete public and private infrastructure required to establish and implement the standardization, technical regulation (TR), metrology, inspection, testing, certification, and accreditation services needed to prove that products and services meet defined requirements, whether demanded by authorities or the market.

Enterprises and Testing Laboratories Show Major Deficiencies in the Adoption of Modern Quality Practices

A targeted survey of enterprises showed that quality improvement and quality assurance are not seen as crucial drivers of competitiveness. Although most firms reported having implemented quality management systems (QMSs), fewer than half were actually certified to international management system standards such as ISO (International Organization for Standardization) 9001 or ISO 14000, most of which were not issued by credible certification bodies. That in many cases the staff of the interviewed enterprises knew very little about the implemented management system shows how much the degree of QMS implementation is questionable.

A weak market for quality-related services, such as certification, testing, and calibration, poses further challenges to product quality in Armenia.

A survey of laboratories showed that in most cases their personnel have limited knowledge of modern measurement methods and uncertainty of measurement, as well as application of QMS according to the relevant ISO and IEC (International Electrotechnical Commission) standards and guides. Personnel also lacked training in the use of new equipment. In many cases, conditions in the laboratories (such as temperature, humidity, and power supply) were not conducive to meaningful laboratory results. The measurement results of the testing laboratories are doubtful because there is no documentation of their traceability to national measurement standards. One-third of laboratories in the survey had never participated in measurement intercomparisons.

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Enterprises in the survey point to a shortage of private certification bodies and testing laboratories. Armenia's standardization body, the National Institute of Standards (NIS), is still (incorrectly) considered to be the national certification body, and there is limited competition in this market. An important limiting factor for the market's development is that, according to the national legislation, product certification bodies need to have their own testing laboratories. The intention was to promote the development of independent private laboratories, but the result was to impede it. This problem does not exist in EU or Organization for Co-operation and Development countries, where the market for independent laboratories is thriving.

Many shortcomings in quality practices in enterprises and in quality-related services can be traced to deficiencies among public NQI institutions.

Several gaps can be directly traced to deficiencies in the national standardization, accreditation, and metrology systems.

— First, exporting enterprises are faced with a parallel system of documentary standards. They need to comply with (a) GOST standards for the domestic, Russian, and other Commonwealth of Independent States markets and with (b) ISO and IEC standards in many export markets.[15] This duplication increases production costs.

— Second, no real industrial calibration system is in place in Armenia. Measurement equipment in industrial production processes and in both in-house and commercial laboratories either are only "verified" by the National Institute of Metrology (NIM), which does not have the capacity to calibrate them, or need to be calibrated by equipment suppliers. Although verification can give a "yes" or "no" for consumer protection purposes, it does little to improve product quality. Moreover, enterprises and laboratories displayed limited knowledge of the difference between the concepts of verification and calibration.

— Third, Armenian certificates are not recognized abroad, including in Russia. This lack of international recognition is a major obstacle for Armenian companies wishing to export. It is directly linked to the quasi-inexistence of internationally accredited certification bodies in Armenia, the lack of international recognition of the national accreditation system, and the lack of international traceability in the national metrology system. Among the surveyed enterprises, the evaluation of NQI services varied from "very good" to "incompetent and corrupt," but the majority expressed dissatisfaction.

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[15] Many of the newer GOST standards, especially recent GOST R standards, are identical or equivalent adoptions of ISO or IEC standards; however, thousands of old GOST standards are not identical. Older translations of ISO and IEC standards often do not reflect the standards' real content.

The Current Legislative and Institutional Framework Is Largely Inconsistent with International Best Practices

Current NQI laws do not reflect the norms, guides, and recommendations of international organizations such as ISO, IEC, the International Organization of Legal Metrology (OIML), the International Laboratory Accreditation Cooperation (ILAC), and the International Accreditation Forum (IAF). Moreover, the mandatory character of certain national standards differs from accepted international practices, where the national standards body does not have the authority to make standards mandatory.

The existing system of elaboration and implementation of TRs has a number of gaps. In accordance with international practices, the elaboration of TRs is delegated to relevant line ministries, and the Ministry of Economy (MoE) coordinates and supervises this work. Unfortunately, officials in the line ministries have no relevant experience and are not trained in the elaboration of TRs. Although TRs, according to key stakeholders, are "somehow based on EU directives," they are "not followed 100 percent for lack of technical capacity." The requirements contained in the EU directives are often "graded" by means of the introduction of different levels of strictness.

Although some progress was made in restructuring the NQI in the past few years, reforms remain largely incomplete. On the positive side, the old Gosstandart was transformed into four main NQI institutions:
1. National Institute of Standards
2. National Institute of Metrology
3. Accreditation Agency
4. State Inspectorate for Market Surveillance and Consumer Rights Protection.

But in all cases, important gaps must be overcome.
- The institutions are still not independent and still fully or partially depend on the MoE.
- Decisions are not transparent. The institutions are not impartial and are subject to conflicts of interest.
- The private stakeholders of the NQI (enterprises, business organizations, laboratories, consumer and environmental protection nongovernmental organizations, and the scientific community) do not participate in the governance of the NQI institutions, with the exception of the Accreditation Council.

The coordination of the Armenian NQI faces several challenges. On the positive side, the horizontal responsibility for the development of the NQI is the responsibility of the MoE. However, two deputy ministers and two divisions are responsible for NQI policy. This situation can produce unnecessary conflicts and problems.[16] Coordination with the relevant line ministries (the Ministries of Agriculture, Health, Energy, Nature Protection, Urban Development, Emergency, and Justice) is also lacking and not clearly regulated.

Inspection and legal metrology are particularly ambiguous areas. The roles, responsibilities, and technical capabilities of the various agencies involved in these areas are unclear. The State Inspectorate for Market Surveillance and Consumer Rights Protection is involved in a mix of legal metrology, inspection, and some aspects of market surveillance. Because of its limited technical capacity, the inspectorate is active only in high-risk areas and products.

The conclusion is that the current legislative and institutional framework is largely inconsistent with international best practices and leads to an ineffective NQI.

The National Metrology System

The national metrological system consists only of the NIM and its branches. No other calibration or verification laboratories exist in the country.

A country's scientific and applied metrology system ensures the maintenance and development of the national measurement standards and their traceability to the International System of Units (Système International d'Unités, or SI). A country's industrial metrology system provides internationally recognized calibration services to producers and testing laboratories to ensure that measurements are reliable and of known uncertainty. Scientific and applied metrology and industrial metrology do not exist in Armenia because the national measurement standards held by NIM are not traceable to the SI and are not disseminated to industry. As a specific result of inadequate existing legislation, NIM mostly acts as a state control agency that "verifies" measurement instruments; it does not serve industry sufficiently. Moreover, because of the lack of measurement traceability, NIM is only partially successful at verification.

NIM's technical capacity is limited for two reasons: its personnel, who are of an advanced age and not trained in the application of modern calibration methods, and its equipment,

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[16]Meanwhile, all NQI responsibilities are concentrated in a newly created division.

which is mostly obsolete. Environmental conditions in the NIM laboratories and entire NIM premises are not adequate for calibration laboratories.

NIM acts and is perceived as an instrument of state control rather than as a means of supporting industrial competitiveness. Until recently, metrology has not been seen as an instrument and service that can help industry improve its production processes and the quality of its products.

The National Standardization Body

In Armenia, standardization is not a sufficiently open and transparent process. NIS is not an independent body because the national representative is the MoE and the standards are signed by the Minister. Hence, standards give the impression of being obligatory but are not legally so. Industry and consumers are underrepresented in the standardization process. The existing six technical committees are not very active. Only a few enterprises participate in the activities. Very little of what NIS is doing in standardization reflects stakeholder needs and interests. The lack of awareness and engagement by private stakeholders—in particular small and medium-size enterprises—is also a factor. Thus, standardization activities are not demand driven or service oriented.

The lack of interest in standardization can also be seen in the low demand for NIS's services: 70 enterprises have subscribed the standard information services, 350 to 400 standards are bought per year, and the technical barriers to trade inquiry point has realized 80 notifications since its installation in 2003.

The disconnect between NIS and the needs of the economy is reflected in the composition of Armenia's 20,000 standards. The large majority are GOST standards, most of which are technologically obsolete and incompatible with ISO/IEC standards. One-quarter are "technical specifications," or standards produced by individual firms, that should not be part of the national standards collection.

On the one hand, the Training Center is a very flexible organization because it has one director and a pool of four to five experts, who are contracted if there is a real demand. On the other hand, the training is theory oriented and the staff has little practical knowledge of international NQI issues. Staff members who work in certification bodies must pass the NIS Training Center's courses, which could provide a certain form of control.

The combination of standardization and certification activities produces an important conflict of interest that needs to be addressed.

Given NIS's limited standardization activities, it is unclear why more than 50 people are employed in standardization, including administrative and technical personnel.

In sum, NIS is subject to conflicts of interest and does not develop standards that reflect the economy's needs.

The Accreditation Agency

The structure and the operational procedures of the Accreditation Agency (AA) are not in line with international practices. The agency is not politically independent, nor is it independent with respect to its accreditation decisions, because it is part of the MoE and the Minister signs accreditations. There is no separation between the board that develops the accreditation policy and the technical board that makes accreditation decisions. Many of these challenges arise not only from the legal and institutional framework but also from the very limited technical competence of the staff. Few staff members have been trained in ISO/IEC standards and ILAC and IAF recommendations, and almost none speak English, which is essential for understanding international requirements and receiving appropriate training abroad.

The scope of accreditation is limited in Armenia. It includes only testing laboratories and product and QMS certification bodies. Inspection and certification bodies for persons are not accredited, and the law does not provide for accreditation of calibration laboratories.

As a result of these gaps, the supply market for conformity assessment services in Armenia is unreliable, and domestic certificates, test results, and measurements are not recognized abroad. This situation is an obstacle to quality improvement and imposes additional costs for retesting and recertification in importing countries.

The AA does not provide technically credible or impartial accreditation services and, as a consequence, does not serve the needs of the economy and is not recognized abroad.

6.2. Recommendations

Reforming the Legal and Institutional Framework

Armenia must reform its NQI to meet the needs of its economy and the requirements of the deep and comprehensive free trade agreement (DCFTA) with the EU.

An NQI council should be established in which the most important stakeholders are represented. The council should develop and discuss the strategic policy proposals and monitor the implementation of the necessary changes. Such a council could be established in the president's or prime minister's office. The executive function can be delegated to the minister of economy. A strategic plan should cover a period of 8 to 10 years and aim for the development of an internationally recognized NQI.

National laws should be reformulated to conform to international best practices. The government can enact a general quality law that includes the most important aspects of the NQI; specific laws (on measurement, conformity assessment, standardization, and so forth); or a combination of general and specific laws. The more specific technical issues should be formulated in amendments, decrees, and secondary legislation. Advice of international experts who have broad experience in the respective fields and who are also aware of the international tendencies is recommended.

The institutional landscape of the NQI should be restructured to ensure political independence, transparency, and impartiality. Such restructuring is particularly important for the four existing main bodies—NIM, NIS, AA, and the State Inspectorate for Market Surveillance and Consumer Rights Protection (which must be transformed into a market surveillance institution)—but also extends to the certification and technical inspection bodies. The main stakeholders (the government, enterprises, laboratories, consumers, and the scientific community) should participate in the NQI decision-making process—specifically in the governing, advisory, or trustee bodies of NIM, NIS, and AA. Mandatory and voluntary standards and procedures need to be clearly defined in agreement with international rules developed under the World Trade Organization and—in the case of the DCFTA—by the European Commission.

In the short term, Armenia's NQI will be able to cover only the country's most basic needs. In some cases (for instance, research and development, food safety, and health), cooperation with foreign NQI bodies will be indispensable.

Developing a National Metrology Institute

A new national metrology institute (NMI) of limited size (roughly 25 to 30 staff members) should be established to develop scientific and industrial metrology in Armenia. Its aim

should be to secure traceability to the SI and to disseminate the units to industry and society. The existing NMI could focus on legal metrology and provide certain services to industry while a new NMI was being established. In the future, the management and staff of the two institutions should be clearly separated. Which institution will realize the tasks of legal metrology in the future—the new NMI or another body—should be decided during the process of reforming the metrology system in Armenia.

Armenia should explore the possibility of designing one or more other laboratories for certain fields of chemical measurements. It is unlikely that the NMI can develop these capabilities in-house in the short to medium term. This requires more staff and costly investments in equipment. However, chemical traceability is required to the export many of Armenia's products, including food products.

The new NMI's structure should be harmonized with international best practices. A consultative board should include stakeholders (the public and private sectors, the scientific community, laboratories, and consumer and environmental protection nongovernmental organizations). A marketing and financing program (business plan) should be developed to ensure the development of the NMI according to the real needs of economy, trade, and society in Armenia.

National measurement standards should have traceability to internationally recognized NMIs—and hence to the SI—through an unbroken chain of measurement comparisons (that is, calibrations). This effort will require active international cooperation with other NMIs—in particular the step-by-step active participation of NMI experts working on the technical committees of the Euro-Asian Cooperation of National Metrological Institutes (COOMET), the respective regional metrological organization. Membership in OIML should be attempted to ensure development of the legal basis for metrology within the international rules and tendencies.

To serve its national needs, Armenia should prioritize the development of following metrological laboratories:
- Mass and weighing instruments
- Pressure (and force)
- Temperature
- Electricity
- Flow
- Metrology in chemistry (by considering designate institutes)

Developing these laboratories will require

- Purchasing up-to-date measurement standards and equipment
- Training
- Ensuring traceability to the SI

Starting with a single pilot laboratory is recommended. The laboratory's staff will require training in the relevant standards and measurement methods and in implementation of a management system that meets international requirements (ISO/IEC 17025). Staff members should have good knowledge of English.

An essential point is to hire young, motivated staff who speak English and will be the future experts for responding to national needs and participating in international activities. Attracting and maintaining such a staff will require the following:

- Generating good working conditions
- Encouraging personal development
- Adopting a salary system that guarantees that young, experienced staff will not leave NIM for private business

From the start of the rebuilding effort, the cooperation of the neighboring countries should be sought. Although at first the main task will consist of developing a basic structure that includes the most urgent components, coordination with countries such as Georgia (in, for instance, the fields of electricity, radiation, and metrology in chemistry) is important. Other countries include Belarus, Kazakhstan, and Ukraine. Such coordination could help satisfy the basic needs of industry more rapidly and save costs.

Given the poor state of NIM's existing facilities, the development and modernization of metrological laboratories will require either a new building or fundamental retrofitting of existing facilities (that is, installation of air-conditioning systems, floor construction, and so forth). Both approaches are expensive.

Achieving international recognition of the NMI's laboratories will require the following steps over a period of six to eight years:

- Successful participation in regional and international intercomparison measurements (organized by COOMET) to register so-called calibration and measurement capabilities in the International Bureau of Weigts and Measures (BIPM) Key Comparison Database

- Accreditation of selected laboratories by an internationally recognized accreditation body or self-declaration (peer review)[17]
- Signing of the International Committee of Weights and Measures (CIPM) Mutual Recognition Agreement

New staff members should be hired for industrial and scientific metrology, and these new hires should be qualified in theoretical and practical metrology according to specific training plans. Training on calibration and verification of measuring instruments based on internationally recognized technical standards is urgent for all staff members. Several specific training activities are proposed in this report. Only some younger staff members speak English, a situation that impedes the development of the urgently needed international cooperation.

Restructuring the National Standards Body

The national standardization body, NIS, should be restructured and downsized, and its governance and management should be revised to reflect international norms.

NIS should be the national standards body in legal and practical terms. It should be governed by a superior body with a balanced representation of the major private and public stakeholders. The principle of balanced representation should be introduced to technical bodies as well. It should be very clear that all standards are voluntary.

Two options are available to eliminate conflicts of interest:
1. Separate fully and immediately the standardization and certification divisions of NIS.
2. Keep them together in the medium term but strictly separate the management of the two divisions and build firewalls between them.

In both cases, a business plan or a marketing and financing concept should be developed. Keeping a strict separation in option (b) can be expected to be difficult to implement. Option (a) will be more effective.

NIS standardization activities should be more demand driven. As a start, the standardization staff should be reduced to approximately 20 people (including administration). Technical committees should reflect stakeholder needs and expectations and mirror technical committees in regional and international organizations. The registration of "technical specifications," a relic of Soviet times, should be gradually abandoned.

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[17] self-declaration includes still on-site peer review by internationally recognized experts

NIS technical officers should receive training in fulfilling their functions as project and process managers, facilitating the technical process, providing guidance to stakeholders concerning the rules to be observed, processing national standards, coordinating Armenia's position in international bodies, and managing the data and information flow between the different levels and stakeholder groups. First, NIS should adopt international standards to national conditions; the development of national standards will be the exception. Participation in the technical committees of ISO, IEC, and other international standardization organizations should be activated by the formation of national mirror committees.

The Training Center's capacity should be strengthened to train national trainers on international best practices in standardization (including good regulatory practices). In this way, the center can become a sustainable engine of the modernization and approximation process.

NIS should be more active in ISO and seek some form of membership in the European Committee for Standardization. Membership in IEC and the European Committee for Electrotechnical Standardization is also desirable.

Establishing a New, Independent National Accreditation Body

Immediately establishing a new, independent national accreditation body will be necessary to achieve international recognition in the medium term.

The government must first decide whether to implement its own small national accreditation body (five to seven staff members) or to allow foreign accreditation bodies to provide services in the country. In the case of the latter, the government must decide in which areas such bodies may serve and to what extent. This decision must take into account the high costs of maintaining a national accreditation body. When the market for accreditation is not yet developed, particularly in small, emerging economies, accreditation cannot be self-financed, and state support is necessary.

The accreditation process must be conducted under the principles of political independence, transparency, impartiality, and confidence. Hence, the national accreditation body needs to be independent from policy-making bodies such as the MoE. It could be a public-private partnership established as a private nonprofit body or an independent public body. All main public and private stakeholders (of the NMI and national standards body) should be included in the Accreditation Council. The accreditation process should comply with international

standards such as ISO/IEC 17011:2004. The relationship between the national accreditation body and the NMI, in particular for using the metrology experts for the assessment process, should be regulated in an officially agreed form.

Once established, the national accreditation body should develop accreditation processes in relevant fields, one at a time, starting with calibration and testing laboratories, product and QMS certification bodies.

The evaluation and decision-making process must be performed by persons who know, understand, and apply international standards. Training in accreditation means preferably "learning by doing" (that is, through lectures, practical application, coaching, and so forth) and requires international experts with practical experience in applying the ISO standards and ILAC and IAF guides. The national accreditation body will need to develop a broad pool of specialists. In some cases, hiring foreign experts will be necessary.

The national accreditation body should establish a close and permanent relationship with the relevant international organizations, including the European Cooperation for Accreditation (EA), ILAC, IAF, and perhaps the Asia Pacific Laboratory Accreditation Cooperation. If a cooperation contract were in place, EA could help in obtaining the necessary technical information and developing the accreditation system.

International recognition through a mutual recognition agreement with ILAC and IAF could be achieved within approximately six years.

Reorganizing the System of Technical Regulations, Consumer Protection, Market Surveillance, and Inspections in Accordance with European Rules

The government should clarify the organization of the system of TRs, consumer protection, and market surveillance and ensure its compatibility with international and European norms.

A first step will be to educate and inform all interested parties about concepts, status, objectives, similarities, and differences between TRs and standards. This step will entail awareness-raising campaigns and training of line ministry officials on the elaboration of TRs. The establishment of interdisciplinary and interministerial working groups for the elaboration and implementation of priority TRs should be promoted. Market inspectors will require training in international and EU surveillance methodology and practices.

Achieving some level of harmonization with the EU will require adopting equivalent or identical priority European directives. New Approach directives must be adopted in full and

be largely unchanged, and national implementation of the relevant harmonized European standards and conformity assessment procedures is required. Implementation should be done step by step in accordance with national needs and the development of technical competence. This approach would help to break down existing corrupt processes in the field.

Finally, an effective regulatory system will require defining and clearly distinguishing between the tasks of legal metrology, technical and other inspections, and market surveillance and assigning those tasks to specific institutions.

Strengthening the Capacity and Competence of Armenian Testing and Calibration Laboratories

Improving quality and consumer protection in Armenia will entail strengthening the capacity of the country's network of testing and calibration laboratories.

The government should take active steps to raise awareness of the instruments, methods, and procedures (including QMSs) required to make testing results reliable and credible. For this reason,
   1. An awareness campaign should also be targeted to laboratories.
   2. Representatives of the laboratories should participate in the NQI council and in the boards of the national metrology, standardization ,and accreditation bodies.
   3. The government should promote the establishment of laboratory associations and their linkage to relevant international organizations.

The government should invest in improving the environmental conditions in laboratories to secure stable and reliable measurement and testing results, in improving the technical capacity of laboratory personnel, and in implementing a QMS in laboratories. Such investments could be done on a match-funding basis in private laboratories and as targeted subsidies in public laboratories. Any investments in upgrading public laboratories or in creating new laboratories should be the result of proper market demand assessments and of a positive assessment of the management practices and governance of the laboratories.

Cooperating with International Donors and Technical Organizations

In the area of NQI, a large number of international donors and technical organizations are active: the World Bank Group, the Food and Agriculture Organization, the United Nations Industrial Development Organization, the United Nations Development Program, the International Trade Commission, the EU, the International Association for Energy Economics,

Physikalisch-Technische Bundesanstalt, the German Technical Cooperation, and the Swedish International Development and Cooperation Agency, among others. Sometimes the activities are complementary, but sometimes they overlap. In the past, some projects were implemented without taking into account the existing demand and the real current and future needs of a country and the likelihood of maintaining and developing the implemented technical capacities. Training of technical personnel to a suitable level of competency was also a weak point.

Since the middle of 2009, a coordination process has evolved among the different international organizations and between the organizations and the MoE. This effort is meant to harmonize activities and impede overlaps. Strengthening this process by better using the strengths and special areas of expertise of the different institutions is highly recommended. Then rapid development of NQI in accordance with international requirements and emphasizing the DCFTA negotiation process will be possible.

To summarize, immediate priorities include:
- Create an NQI Council
- Restructuring the NQI by:
    o Creating a new basic independent accreditation body
    o Creating a new national metrology institute
    o Downsizing the national standards body and clearly separating standardization from conformity assessment.
- Removing mandatory requirements and technical specifications in conformance with international guidelines.
- Aligning the NQI legislation with international requirements.
- Clarify the organization of the technical regulations, consumer protection and market surveillance system

In the short to medium term, Armenia will need to invest in:
- Developing the technical capacity of the new national metrology institute and seeking international measurement traceability.
- Building staff and organizational capacity in all NQI institutions.
- Seeking membership in international NQI organizations.
- Raising awareness for NQI needs in the private sector.
- Building technical capacity for quality upgrading and quality services in the private sector.

- Developing new accreditation scopes or attracting a foreign accreditation body for certain scopes.
- Seeking multilateral recognition in the area of accreditation.

In the short run, costs for a new metrology institute could range from USD 4-6 for a new building; USD 4-6 million for new equipment; USD 1 million for IT equipment, information systems and databases; tens of thousands to hundreds of thousands of USD for memberships in the main international NQI organizations; training and consultancy costs for all NQI institutions could range in the hundreds of thousands of USD annually for the first few years. Other costs will include expert contributions for institutional policies, new legislation and awareness raising.