

INTERNATIONAL DEVELOPMENT IN PRACTICE

# Ethiopia

## QI Toolkit Case Studies

Martin Kellermann

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## About the Author

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# Abbreviations

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BMZ	Federal Ministry for Economic Cooperation and Development (Germany)
BSCI	Business Social Compliance Initiative
CMC	calibration and measurement capabilities
COMESA	Common Market for Eastern and Southern Africa
DAG	Donor Assistance Group
DAkks	German Accreditation Body (Deutsche Akkreditierungsstelle)
DTIS	Diagnostic Trade Integration Study
ECAE	Ethiopian Conformity Assessment Enterprise
ECBP	Engineering Capacity Building Programme
ENAO	Ethiopian National Accreditation Office
ESA	Ethiopian Standards Agency
EU	European Union
GDP	gross domestic product
GIZ	German Agency for International Cooperation (Deutsche Gesellschaft für Internationale Zusammenarbeit)
IAF	International Accreditation Forum
IEC	International Electrotechnical Commission
IF	Integrated Framework for Trade-Related Technical Assistance to Least-Developed Countries
ILAC	International Laboratory Accreditation Cooperation
IMF	International Monetary Fund
ISO	International Organization for Standardization
ITC	International Trade Centre
JICA	Japan International Cooperation Agency
LDC	least-developed countries
MoCB	Ministry of Capacity Building
MoTI	Ministry of Trade and Industry
NMIE	National Metrology Institute of Ethiopia
QI	quality infrastructure
QSAE	Quality and Standards Authority of Ethiopia
SPS	sanitary and phytosanitary
TBT	Technical Barriers to Trade

TBT Agreement	Agreement on Technical Barriers to Trade (WTO)
TeCAT	Technology Capability Accumulation and Transfer
TRIM	Trade-Related Investment Measures
TVET	technical and vocational education and training
UN	United Nations
UNDP	United Nations Development Programme
UNIDO	United Nations Industrial Development Organization
USAID	U.S. Agency for International Development
WTO	World Trade Organization

# Ethiopia

## QI Toolkit Case Studies

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*Abstract: Ethiopia reengineered its quality infrastructure (QI) as a precursor to World Trade Organization (WTO) membership. This comprised the unbundling of the Quality and Standards Authority of Ethiopia (QSAE) into four independent entities—for standards, metrology, accreditation, and conformity assessment—to comply with international good practices and with the requirements of the WTO Agreement on Technical Barriers to Trade. Thereafter, these four entities were supported in obtaining international recognition. It was a complex undertaking that required a clear government vision and massive support at the political level.*

### EXECUTIVE SUMMARY

Ethiopia wished to integrate better with international global markets to initiate socioeconomic development. As a first step, Ethiopia applied for accession to the World Trade Organization (WTO) in 2003. Its national quality infrastructure (QI) and technical regulation regime were evaluated for compliance with the WTO Agreement on Technical Barriers to Trade (TBT Agreement) in 2006 under a United Nations Development Programme (UNDP) project. The evaluation concluded as follows:

- The national standards body—the QSAE—followed a fully integrated approach by providing all QI services (standards, metrology, and conformity assessment), which made the QSAE a type of monopoly.
- The QSAE was responsible for the registration of other laboratories (that is, a type of accreditation), which constituted a conflict of interest with its own laboratory services.
- The QSAE was responsible for the administration of more than 250 mandatory standards; and this activity, in combination with its own testing and certification, constituted a serious conflict of interest and a trade barrier.
- The technical regulation regime of Ethiopia was found to be ad hoc, fragmented, and often noncompliant with WTO TBT Agreement requirements.

- None of the QI organizations in Ethiopia were accredited, thus denying international recognition for the outputs of those organizations.

All these issues were real challenges for the Ethiopian industries endeavoring to become more export-oriented, because in these markets products and services must be competitive not only on delivery and price but also on quality—quality that must be demonstrated through internationally recognized QI services. In addition, the conflicts of interest and noncompliance with WTO TBT Agreement requirements would have to be addressed before Ethiopia's WTO accession.

Two German-funded development projects provided the major impetus for the reengineering of Ethiopia's QI. The first of them, the Engineering Capacity Building Programme (ECBP), was a joint venture between the German and Ethiopian governments. It was implemented in two phases from 2006 to 2012 and cofunded, with Germany providing €54.3 million, and the Ethiopian side was supposed to match this (Becker, Schäfer, and Diergardt 2012). The German side was managed by the German Agency for International Cooperation (GIZ), and the Ethiopian counterpart was the Ministry of Planning. A parallel development program of €2.4 million—"Support in the Development of a Customer-Oriented Quality Infrastructure in Ethiopia," which was included in the ECBP framework—was implemented by the National Metrology Institute of Germany (PTB) from 2006 to 2012.

The ECBP had four components: (a) university reform of engineering curricula, (b) establishment of a modern technical and vocational education and training (TVET) system, (c) reengineering of the national QI, and (d) capacity building of industry to better use the national QI services. The PTB project focused on capacity building in the national QI, with metrology and testing laboratories being the main beneficiaries. The two projects were coordinated, as required, by the German Federal Ministry for Economic Cooperation and Development (BMZ). A GIZ field office was established in Addis Ababa for the massive ECBP program with German and Ethiopian staff. This office was also used by the PTB project.

During the first phase of the ECBP, a comprehensive QI strategy was developed in 2006–08 with the involvement of many stakeholders from both the public and private sectors (ECBP 2009). Other than an analysis of the country's QI and its challenges, it also contained QI benchmarking of countries such as China, Germany, Malaysia, and South Africa. The main recommendation of the QI strategy was to split the QSAE into four independent entities: the Ethiopian Standards Agency (ESA), the Ethiopian Conformity Assessment Enterprise (ECAE), the National Metrology Institute of Ethiopia (NMIE), and the Ethiopian National Accreditation Office (ENAO). These four QI organizations were to be accountable to the Ministry of Science and Technology as part of the overall science system.

At the same time, the QSAE's regulatory activities were to be totally separated from the four QI organizations. The administration of mandatory standards was to be placed in an independent regulatory agency under the Ministry of Trade and Industry (MoTI), and the trade metrology activities were devolved to the regional trade inspectorates of the same. The draft QI strategy was approved by the Council of Ministers in 2009.

During that time, the Ethiopian government also embarked on a major reengineering of the whole civil service. The Ministry of Planning was created

specifically to spearhead this process, and it became politically one of the most influential ministries. Once the civil service reengineering program had been completed, this ministry was disbanded in 2010. The civil service reengineering delayed the QI reforms in two ways: First, because the reengineering of the QI was subsumed into this overall civil service program—which took years longer to be realized than was originally planned—the QI reengineering also took much longer than planned for in the QI strategy. Second, the legislative framework for the various QI organizations and the separation of regulatory activities had to be developed and promulgated. Hence, the new QI structures were only established in 2011 (table 1).

Even before the split of the QSAE, however, capacity building in metrology, testing laboratories, and certification was under way:

- A quality management certification body, QSAE-Cert, was established; its auditors were trained; and its own management system was developed and implemented. QSAE-Cert was accredited by the German Accreditation Body (DAkkS) in 2009.
- The metrology laboratories of the QSAE (later NMIE) were supported in developing their calibration and measurement capabilities through regional interlaboratory comparisons. Some of the metrology laboratories were

**TABLE 1 Snapshot of quality infrastructure (QI) Reform in Ethiopia**

BEFORE REFORM	AFTER REFORM
The national standards body, the Quality and Standards Authority of Ethiopia (QSAE), was responsible for standards, inspection, testing, certification, metrology, and accreditation; hence, numerous conflicts of interest existed.	QSAE was split into four QI organizations, each dealing with a specific QI service: standards, metrology, accreditation, and conformity assessment. These four entities were accountable to the Ministry of Science and Technology.
The QSAE was responsible for the implementation of mandatory standards and trade metrology.	Implementation of mandatory standards and trade metrology was separated from the QSAE and moved to the Ministry of Trade and Industry. Trade metrology was further devolved to regional trade inspectorates.
No quality management system certification body was established in Ethiopia. Clients had to use expensive foreign certification bodies.	QSAE-Cert was established as a quality management certification body, its auditors were trained, and its processes and documentation were developed and implemented. QSAE-Cert was accredited by the German Accreditation Body (DAkkS).
The equipment of the metrology laboratories of the QSAE was of low accuracy and not capable of getting international recognition.	The equipment of the metrology laboratory in the QSAE (later the National Metrology Institute of Ethiopia [NMIE]) was modernized, and systems to gain international recognition were introduced. Laboratory intercomparisons were conducted and continue at the regional level.
The QSAE's accreditation activities did not meet international standards, and no international recognition by International Laboratory Accreditation Cooperation (ILAC) or the International Accreditation Forum (IAF) was possible.	The independent Ethiopian National Accreditation Office (ENAO) was established, and support to achieve international recognition by ILAC and the IAF was initiated.
University engineering curricula were totally outdated and did not meet the needs of industry.	More than 100 engineering curricula and training materials were modernized and aligned with industry needs. The QI benefits from more and better-trained technical staff.
No vocational training system for technicians existed.	A vocational training system for technicians was established, 250 training institutions were accredited, 1,500 trainers were trained, and regional agencies were established to oversee the training of 300,000 technicians in 1,000 industries.
The investment climate was suboptimal; hence, exporting possibilities were suboptimal.	The investment climate was enhanced with the removal of trade-restrictive taxes and import duties. Strategic industry associations were strengthened, and trade promotion originations were capacitated. A higher demand for QI services has resulted in growth in strategic export sectors.

accredited to ISO/IEC 17025 (“General Requirements for the Competence of Testing and Calibration Laboratories”).

- Several testing laboratories of both the ECAE and the private sector were supported in obtaining accreditation.

The university reform project provided for a total revamping of the curricula for engineering students, bringing them to international levels by introducing modern curricula in the 274 public technical colleges. The TVET project established vocational training agencies in the regions to oversee the training of 300,000 trainees in 1,000 enterprises. The QI profited from these measures as trained technical personnel became available.

Exports and formal employment in selected industrial sectors rose. Since 2005, for example, Ethiopia’s QI services have made it an increasingly attractive production and investment location in the textile and leather sectors on the African continent. The Ethiopian pharmaceutical sector has increasingly substituted previous drug imports. In addition, more than 30 companies in various sectors have been supported in gaining certification to ISO 9001 (“Quality Management Systems—Requirements”),<sup>1</sup> ISO 14001 (“Environmental Management Systems—Requirements with Guidance for Use”),<sup>2</sup> and other relevant standards.

## COUNTRY CONTEXT

Ethiopia, with its capital city of Addis Ababa, is on the Horn of Africa. It shares a border with Eritrea to the north and northeast, Djibouti and Somalia to the east, Sudan and South Sudan to the west, and Kenya to the south. With nearly 100 million inhabitants, Ethiopia is the most populous landlocked country in the world, as well as the second-most-populous nation on the African continent after Nigeria.

Ethiopia is classified as a low-income country by the World Bank. But, according to the International Monetary Fund (IMF), Ethiopia was one of the fastest-growing economies in the world, registering over 10 percent economic growth from 2004 through 2009. It was the fastest-growing non-oil-dependent African economy in the years 2007 and 2008. Its growth decelerated moderately in 2012 to 7 percent and is projected to be 6.5 percent in the future. Despite its fast growth, its gross domestic product (GDP) per capita is still one of the lowest in the world, and its economy faced serious structural problems. Agricultural productivity remains low, and frequent droughts still beset the country (IMF 2012).

Ethiopia is a member of the Common Market for Eastern and Southern Africa (COMESA) and has signed bilateral trade agreements with several countries, as well as being included in some of the preferential trade agreements, such as the African Growth and Opportunity Act (with the United States) and the Everything but Arms initiative (with the European Union).

Ethiopia is not a member of the WTO but started the process of accession in 2003.<sup>3</sup> This decision marked an important step in the country’s process of integration into the global economy. The WTO General Council accepted Ethiopia’s request but acknowledged that institutional capacities in the country required further development. Ethiopian authorities envisaged the accession process to be completed by 2009 or 2010, but this did not happen. During the process of becoming a WTO member, some fundamental policy and institutional changes would have to be implemented, including those related to the QI and the technical regulation regime.

## EARLY QI DEVELOPMENT AND ISSUES

Ethiopia's national standards body, the QSAE, was established in 1970 and became operational in 1972. Its founding legislation was amended a few times, most notably with the far-reaching Quality and Standards Authority of Ethiopia Establishment Proclamation No. 102/1998 and the Standards and Certification Council of QSAE Proclamation No. 413/2004. The responsibility for metrology was conferred on the QSAE through the Weights and Measures Regulations Legal Notice No. 432 of 1973. In 2003, when Ethiopia started the process of accession to the WTO, the QSAE was already a member of the International Organization for Standardization (ISO), International Electrotechnical Commission (IEC), and International Organization of Legal Metrology (OIML).

Through these laws, the QSAE was mandated to promote and assist in the establishment of quality management practices as an integral function in the social and economic sectors and to assist in the improvement of the quality of products and processes through the promotion and application of Ethiopian standards. Its activities included publishing the national standards, establishing the national measurement standards and providing calibration services, and providing testing and certification services over a wide range of technologies. The QSAE was also responsible for administering standards declared mandatory by the Standards and Certification Council on behalf of MoTI and for strengthening, promoting, and enhancing the reliability of testing laboratories nationwide. Until 2006, the QSAE did not provide quality management certification services.

By 2006, the QSAE had published about 5,000 Ethiopian standards, of which 107 had been declared mandatory. These were supported by a number of testing methods, bringing the number of mandatory standards to nearly 390. A further 400 Ethiopian standards were earmarked at that time to be declared mandatory. Because the compliance with the mandatory standards was coupled with the QSAE product certification mark (that is, rendering its use mandatory by default), this was considered a major barrier to trade.<sup>4</sup> The planning for even more standards to be declared mandatory was a move in the wrong direction.

None of the QSAE laboratories was accredited, nor was any of the other laboratories in the public domain, even though some of them were well equipped and staffed by well-trained technologists. There were no private sector laboratories at that time. The QSAE's product certification scheme was based on ISO/IEC Guide 65 ("General Requirements for Bodies Operating Product Certification Systems"),<sup>5</sup> but it was not accredited either. Ethiopia did not have an accreditation body, but QSAE was given the responsibility to oversee the technical capabilities of the laboratory sector in Ethiopia; in other words, it was to authorize the recognition and registration of quality certification bodies, inspection bodies, testing laboratories, and calibration laboratories operating in Ethiopia. This was a major conflict of interest.

The QSAE remained directly accountable to MoTI, even after the establishment of its council through the promulgation of the Standards and Certification Council of QSAE Proclamation No. 413/2004. Good governance principles would suggest that the QSAE should have been made accountable to the Standards and Certification Council. Its responsibility, however, was limited to approving national standards; it was not given any business strategy or fiduciary responsibilities. This would have negative consequences for the accreditation of

the QSAE, because the relevant international standards generally require governance in the form of independent boards.

Ethiopia's national QI therefore followed a fully integrated approach typical of many low- and middle-income economies well into the end of the 20th century, an approach also favored by some members of the donor community. But this approach soon became progressively problematic as world trade developed, because of its inherent conflicts of interest. Furthermore, none of the Ethiopian QI organizations was accredited. Hence, international recognition was, for all intents and purposes, absent. All of this was a major negative for the country's ambitious plans to transform its economy from one with a largely agricultural base to an industrialized one and to become much more integrated into the world economy.

## PROJECT COMPONENTS AND OBJECTIVES

### Integrated Framework for Trade-Related Technical Assistance to Least-Developed Countries (IF)

In 1997, the IMF, International Trade Centre (ITC), United Nations Conference on Trade and Development (UNCTAD), UNDP, World Bank, and WTO launched the Integrated Framework for Trade-Related Technical Assistance to Least-Developed Countries (commonly abbreviated as IF). This initiative combined the efforts of the multilateral agencies and bilateral donors to help least-developed countries increase their participation in the global economy.<sup>6</sup>

In Ethiopia, the IF-supported activities started in 2002. Steering and technical committees were set up as well as a secretariat within MoTI designated as the IF focal point. As a preliminary step to integrate trade into the national development strategies, a Diagnostic Trade Integration Study (DTIS) was conducted (World Bank 2004). In 2004, the Ethiopian government also prepared an Action Plan for the prioritized DTIS recommendations. In it, the government requested donor support for identified priorities such as trade reform, foreign direct investment, and legal and regulatory strategies (IF/DTIS TC 2004).

MoTI and the UNDP agreed in 2005 that four impact assessment studies to analyze the consequences of Ethiopia's accession to the WTO (studies not covered by other donors) would be funded by the UNDP/IF Trust Fund. These studies would focus specifically on

- Sanitary and phytosanitary measures (SPS) and technical barriers to trade (TBT);
- Trade-Related Aspects of Intellectual Property Rights (TRIPS);
- Trade-Related Investment Measures (TRIMs); and
- Customs valuation.

The TBT and SPS impact assessments were conducted at the beginning of 2006, and they provided the first documented evidence of the challenges facing Ethiopia's national QI and technical regulation regime (Kellermann and Yimer 2006). The WTO TBT Agreement-related study contained many recommendations at the policy as well as the implementation levels that Ethiopia would have to consider seriously before it could fulfill its WTO TBT Agreement obligations. The technical regulation regime was found to be ad hoc, fragmented, and WTO noncompliant, and therefore in need of serious reengineering. Among the

technical regulation practices, it was noted that the mandatory standards system would need to be reconsidered and that its administration would have to be separated from the QSAE. It was also noted that the totality of the legislative framework of the national QI was in serious need of modernization.

As a follow-up to the UNDP's TBT impact assessment study, the U.S. Agency for International Development (USAID), which was supporting the modernization of the relevant Ethiopian legislation before WTO accession, agreed to fund the development of a suite of modern QI draft legislation. This included the development of draft legislation for a technical regulation framework, establishment of an independent regulatory agency to administer mandatory standards, metrology legislation (scientific and legal metrology), legislation for an independent national accreditation body, and a complete revision of the QSAE legislation. Although not used immediately, this suite of draft QI legislation was used a few years later by the ECBP as the basis for the final draft QI legislation in 2010 (as discussed below in the "QI strategy" subsection).

### **National Metrology Institute of Germany (PTB)**

PTB managed a development project that expected its ultimate impact to be the facilitation of sustainable industrial development. The project's specific objective was defined as "support for the development of a customer-oriented quality infrastructure in Ethiopia" (Diergardt 2012). It was funded by the BMZ and was implemented in two phases. The total budget for the two phases, which ended in 2012, was €1.4 million. During a 2012–16 follow-up project ("Promotion of Metrology and Testing"), an additional €1 million was invested for the further development of the metrology infrastructure. The objective of this project was to improve the range of services that the institutions of the national QI offer to trade and industry.

At the same time, the massive ECBP was under way, funded jointly by Germany and Ethiopia (further discussed below). The ECBP was managed by the organization now known as the German Agency for International Cooperation (GIZ).<sup>7</sup> As a result, the BMZ saw to it that the two German development agencies (GIZ and PTB) coordinated the two programs in a clear and unambiguous way.

The PTB project had a multifaceted approach and included the following:

- *Evaluation and consultancy regarding the governance of QI institutions* (that is, their management and control) as well as the coordination between relevant ministries and these institutions.
- *Support for capacity development in industrial metrology* with a focus on enhanced calibration services and the accreditation of calibration laboratories. The establishment of a functioning legal metrology system was also supported.
- *Support for the establishment of the Ethiopian Laboratory Association* and consultancy concerning compliance with ISO/IEC 17025 to a small number of laboratories to prepare them for accreditation.<sup>8</sup> The chosen laboratories were considered essential for the testing and certification of products for the export market.
- *Capacity development for the QI labor market* by instigating and supporting QI-related programs at tertiary education institutions.

For each of the above elements of the PTB project, specific key outcomes were defined that were more or less fulfilled (see the "Metrology" subsection below). As with most PTB projects, no project office was established in Ethiopia;

instead, PTB used GIZ's permanent office in Addis Ababa, thereby contributing to the overall efficiency of German involvement. As a result, PTB funds could be used fully for capacity building and consultancy provided by PTB short-term experts who undertook various missions. These were managed by a project manager based in PTB's head office in Braunschweig, Germany.

### **Engineering Capacity Building Programme (ECBP)**

The ECBP was a joint development program of Germany and Ethiopia. It was arguably one of the most ambitious development programs at the time anywhere in the world. The vision and overall goal of the ECBP was that the Ethiopian industrial sector should become competitive and that the living standard of society would be enhanced; that is, employment opportunities for all Ethiopians would be created. The ECBP was cofunded by the German and Ethiopian governments, and approximately €55 million was invested by Germany over the period 2005 to 2012 in two phases. The Ethiopian contribution was on the order of €31 million.

The ECBP's core principles emphasized that it was an Ethiopian reform program and that it would be based on international benchmarking and standards. It was designed as a multilevel project with interventions at (a) the political level (for example, capacity building on joint strategies for development between the government and private sector); (b) the institutional level (universities, colleges, chambers of commerce, and QI organizations); and (c) the individual level (entrepreneurs and small and medium enterprises, SMEs). The ECBP was implemented in two phases—the second phase building on the outcomes of the first phase—and in the four distinct but interrelated components described below.

#### ***Component 1: University reform***

In the first phase of this component, German experts and Ethiopian partners from the Ministry of Capacity Building (MoCB) cooperated to develop concepts for the later reforms of the universities' engineering and technology programs. The reforms included (a) curricula reform, (b) development of university personnel, (c) cooperation between the universities and industry to enable technology transfer, (d) reform of the organizational structures of tertiary education institutions, and (e) development of the curricula for the TVET trainers.

In the second phase, these concepts were implemented throughout the country, and the reform process was progressively transferred to the Ministry of Education, which took complete ownership by the end of 2011.

#### ***Component 2: Technical and vocational education and training (TVET) system***

In the first phase, the professional education strategy was developed and adopted (in 2007), which resulted in a paradigm shift from an input-oriented system to an output-oriented, decentralized, and work-oriented vocational education and training system. Educational visits to Germany supported the decision-making process by the Ethiopian education policy makers. Approximately 350 professional education standards with curricula and 190 career profiles were developed. Industry was involved in these developments through 300 temporary advisory

and technical expert panels. Furthermore, Ethiopia financed the involvement of German experts to provide advanced training for the Ethiopian trainers at relevant vocational training institutions.

The second phase supported the management of the vocational training institutions through management training (by Philippine experts), the introduction of kaizen principles,<sup>9</sup> and the introduction of management information systems. At selected vocational training institutions, experienced German experts were transitionally employed as heads of the institutions. Legislation establishing the federal vocational education agency as well as a national teacher training and education facility was developed and promulgated by the Council of Ministers in 2011.

### ***Component 3: QI reform***

In the first phase, a national QI strategy was developed, which was approved by the Council of Ministers in February 2009 (EDBP 2009). The key component of the QI strategy was the radical reengineering of the QSAE into four independent organizations to provide a better business focus and to remedy the inherent conflicts of interest in the old structure. A certification body, QSAE-Cert, was established to provide ISO 9001 certification services, and it was accredited by the German Accreditation Body (DAkkS) in 2009.

During the second phase, after the promulgation of the necessary legislation in February 2011, the former QSAE was separated into four independent QI organizations: the Ethiopian Standards Agency (ESA), the Ethiopian Conformity Assessment Enterprise (ECAE), the National Metrology Institute of Ethiopia (NMIE), and the Ethiopian National Accreditation Office (ENAO). The ECBP supported the newly established organizations to upgrade their services to international levels. By agreement, PTB focused on metrology (discussed in the earlier PTB section), and the ECBP focused on standards, accreditation, and conformity assessment services. A further element for strengthening the conformity assessment was the establishment of and support for the Ethiopian Laboratory Association.

### ***Component 4: Private sector and business development***

In the first phase, comprehensive planning was undertaken for capacity building in a number of areas, including a microfinancing strategy, promotion of investment (for example, the “Brand Ethiopia” strategy), sectoral business-related service and value chains in cooperation with the United Nations Industrial Development Organization (UNIDO), and the promotion of small businesses. This was conducted at both the federal and regional levels.

At the beginning of the second phase in 2009, the program became more focused on value chain creation, which was more effective in helping to realize the industrialization strategy of the country. Subject-specific teams of experts from GIZ and its partners worked in existing industries in specific sectors such as textiles, leather, agroprocessing, pharmaceuticals, construction, and metal manufacturing. As a result, the outcomes, given the size of the country, were more visible and could be measured more rapidly. Furthermore, exports were facilitated in cooperation with Ethiopian embassies abroad. And through public-private partnerships, multinational organizations started to get involved in the Ethiopian economy.

## PROJECT DESIGN AND IMPLEMENTATION

Many of the development projects during 2005–12 had an influence on the reengineering of Ethiopia’s QI. This section focuses largely on those directly involved with the QI; others may be mentioned in passing. Capacity building within the fledgling QI organizations that emerged from this reengineering is ongoing. The development projects in the various industrial sectors are also ongoing, with new ones being implemented either as follow-ups to the ECBP and PTB projects funded by Germany or as projects funded by other countries, including the following:

- *USAID*: US\$50 million for private sector agricultural development
- *U.K. Department for International Development (DFID)*: £50 million for financial services and the role of women in the business sector
- *Italy*: promotion of the industrial sector
- *Japan International Cooperation Agency (JICA)*: further development of industrial policies
- *European Union (EU)*: €35 million for private sector development, the so-called Transformation Triggering Facility program.

These ongoing projects are not discussed further here. The discussion that follows is limited to 2005–12, when the main reengineering of the QI took place.

### QI strategy

The QI strategy was developed as a cooperative effort among many stakeholders from both the public and private sectors, and it was ultimately completed under the guidance of the ECBP and the Ministry of Planning, which was responsible for civil service optimization (ECBP 2009). Considered in its development was the knowledge generated during the UNDP project to determine Ethiopia’s preparedness for WTO membership (see the earlier IF subsection) as well as the PTB experts’ reviews of the QSAE’s structure and activities (during the first phase of the PTB project). Specific issues that were considered in the development of the QI strategy included the following:

- *Export market challenges* affected some of Ethiopia’s main industrial sectors such as the coffee, textile, and tannery sectors that required access to internationally recognized QI services.
- *Conformity assessment service challenges* included, among others, the cost of foreign-based services in view of the country’s lack of local accredited laboratories and the lack of a quality management system certification body.
- *Legal metrology issues* (that is, weight loss compensation costs) have caused exporters to pay huge sums of money because of faulty deliveries due to the lack of a national legal metrology system.
- *The lack of full ISO and IEC membership* meant that although the QSAE was a lower-level member of the ISO and IEC, it could not participate meaningfully in international standards development activities.
- *The lack of a consolidated consumer policy and legislation*, coupled with the lack of an integrated institutional effort on consumer affairs, weakened consumer protection—a problem aggravated by the generally high levels of illiteracy and poverty.

The QI systems of several countries were reviewed (including those of China, Costa Rica, Germany, Malaysia, South Africa, and Vietnam) to provide guidance for the reengineering of the Ethiopian QI. The needs of stakeholders, especially in industry, were solicited and taken into account. The QI strategy was also harmonized with Ethiopia's emerging science and technology strategy—the Technology Capability Accumulation and Transfer (TeCAT) system, based on the Republic of Korea's example.

The most far-reaching recommendation of the QI strategy was the splitting of the QSAE into four distinct entities, each responsible for a specific element of the QI. As mentioned earlier, these were the ESA, ECAE, NMIE, and ENAO. All of these were to be accountable to the Ministry of Science and Technology, as part of the science system, instead of to MoTI. The QSAE's regulatory activities—namely, mandatory standards and trade metrology—were separated totally, the former established as a regulatory agency under MoTI and the latter devolved to the regional trade inspection authorities.

The draft QI strategy was subjected to public comment and validation workshops. It was finally presented to the Council of Ministers, which approved it for implementation in 2009. However, the original implementation plan contained in the QI strategy could not be followed, because the government had previously started a major civil service reengineering program, named Business Process Reengineering. The QI strategy was subsumed into this overarching program spearheaded by the Ministry of Planning, which had been established specifically for reengineering the civil service.

The larger Business Process Reengineering program obviously took much longer to be realized than would have been the case for dealing only with the QSAE's reengineering. In addition, the legislative framework for the QI had to be either totally revised or developed anew. The draft QI legislation developed under the USAID project a few years previously (as noted in the earlier UNDP subsection) saved a tremendous amount of time because its point of departure was not that different from the recommendations of the final QI strategy. Therefore, these drafts just had to be fine-tuned to be aligned fully with the approved QI strategy modalities. Hence, it would take until 2011 for the separation of the QSAE to become effective. On the other hand, being part of the much larger civil service reengineering program made it easier to enforce the major changes of the QI.

## **Metrology**

Even when the metrology laboratories were still part of the QSAE, technical support was provided to build capacity in these laboratories. Once the National Metrology Institute of Ethiopia (NMIE) was established as an independent entity (as discussed earlier), a focus on strengthening its governance and management structures was added. This was a coordinated effort between PTB and the ECBP, with PTB taking the lead because it had the superior technical expertise. The objectives of the projects were satisfied (or not) in the following ways:

- To ensure that the NMIE's governance and management structures complied with international standards, stakeholders must be represented in a meaningful way. This indicator could not be fulfilled because the NMIE was made

directly accountable to the minister (that is, without a council or board). This would be a challenge to be dealt with in the future.

- To enhance the NMIE's calibration and measurement capabilities (CMCs) and to broaden the scope of its services, four of its laboratories (mass, temperature, volume, and pressure) were accredited by DAkkS. In addition, the NMIE participated in a number of regional interlaboratory comparisons, thereby starting to quantify its CMCs.
- Regarding industrial metrology, technical capacity and accreditation readiness were enhanced in calibration laboratories. Four mobile calibration laboratories were provided for the regions because the country is huge, and adequate transport infrastructure is not available to get equipment routinely to major centers for calibration. The number of calibrations conducted by the calibration laboratories rose from 674 in 2008 to 1,922 in 2011, an increase of 162 percent—far above the project indicator set at 45 percent (Becker, Schäfer, and Diergardt 2012).
- In contrast to the successful developments in scientific and industrial metrology, no capacity building could be undertaken in trade metrology (weights and measures) because of the devolvement of the function to regional trade inspectorates that took an inordinate amount of time. The PTB project ended before this could even be initiated.
- To provide for an adequate number of trained metrologists in the future, metrology courses were established at Addis Ababa, Wollo, Mizan Tepi, and Mekelle Universities. The training of the educators and the development of teaching material was largely undertaken by the Ethiopian partner NMIE, but with technical support from PTB.

In an interesting sideline development, the Ethiopian government entrusted the NMIE with the task of replacing traditional measuring units that were not International System of Units (SI) units—which were still being used in the marketplaces—with SI units and measurement equipment. PTB designed a pilot project for individual markets that was to be implemented by the NMIE.

### Conformity assessment

Conformity assessment support was also a cooperative effort between ECBP and PTB, with both supporting specific entities in specific sectors. Some of the outcomes of this technical support included the following:

- In the first phase of the ECBP, a quality management system certification body, QSAE-Cert, was established in the QSAE to address one of the major gaps in the provision of conformity assessment services in the country. Auditors and lead auditors were trained, the development and implementation of management system documentation were supported, and QSAE-Cert was eventually accredited by DAkkS. The training programs were not limited only to QSAE-Cert personnel but were extended to private industry, from which nearly 180 quality managers were trained.
- Technical support was provided to more than 30 companies that were eventually certified to ISO 9001, ISO 14001, Global Good Agricultural Practices (Global G.A.P.), and other management system standards by QSAE-Cert or by foreign certification bodies in cases where QSAE-Cert did not have the relevant expertise. Specific attention was given to companies in the export

sectors, even for certification schemes based on private sector standards such as Oeko-Tex (environment-friendly textiles), the Business Social Compliance Initiative (BSCI), and Fair Trade.

- Testing laboratories that were members of the Ethiopian Laboratory Association were supported in implementing management systems in accordance with ISO/IEC 17025, including some of the laboratories of the newly established ECAE. Five of the ECAE laboratories were accredited by the ENAO, and the National Animal Health Diagnostic and Investigation Centre and the Leather Industry Development Institute elaborates were also accredited in accordance with ISO/IEC 17025.
- A vocational training course for laboratory technicians was established at the Wingate TVET College, and some trainee technicians concluded their first-year training by the end of 2012.

### **University and vocational training reform**

The university and vocational training reform program is not discussed here in any detail. Some highlights of the program included nearly 100 bachelor's and master's degree study programs that were either revised or newly developed. Industry liaison offices were established in seven technical universities to ensure coordination between industry needs and education curricula. A further five technical colleges and one technical university were established and supported to start operating.

Modern curricula were introduced in all 274 public technical colleges; that is, more than 350 modern educational standards were implemented, along with their curricula. In 2010/11, all the TVET teachers—just over 14,000 in public and private training institutions—were evaluated, trained, and reevaluated. Of these, about 84 percent passed the new requirements (Becker, Schäfer, and Diergardt 2012).

As for the vocational training system, vocational training agencies were newly established in 9 regions, further supporting the training of approximately 300,000 trainees in the 11 regions of Ethiopia in cooperation with approximately 1,000 enterprises. The new vocational training system had been fully implemented in 6 of the 11 regions; that is, training centers were fully operational, trainers were trained, and training and examination materials were developed and used. These included approximately 1,500 trainers trained, 250 vocational training centers accredited, and 175,000 trainees examined. Although absolute figures were not available, it was estimated that about 50 percent of the trainees were female (Becker, Schäfer, and Diergardt 2012).

### **Industrial capacity development**

The industrial development projects of the ECBP were, in the first phase, focused on enhancing the investment climate for relevant industrial sectors and supporting industries in these sectors to start exporting their products. Reform packages that were facilitated included the setting aside of import duties for spares of production machinery, tax relief for the supply of subcomponents for the textile industry, import duty relief for shoe and garment accessories, establishment of a “bonded factory” system for foreign investors, and tax relief for imported chemicals for the pharmaceutical industry.<sup>10</sup>

During the second phase, the ECBP focus shifted to organized industry segments such as business associations. These associations were supported to become more active in supporting their members to grow their businesses. They included the Ethiopian Leather Industries Association, Ethiopian Textile and Garment Manufacturers Association, Ethiopian Millers Association, Ethiopian Pharmaceutical Association, and Ethiopian Women Exporters' Association. The same process was followed to strengthen the trade promotion organizations of various regions, building their capacity for promoting value chain concepts and for acquiring investments from abroad.

Although these interventions were not directly relevant to the reengineering of the QI, they did have an indirect effect, in that the affected industries required more QI services for their increases in production and the quality thereof. It was especially noticeable in the textile and leather sectors regarding exports as well as in the pharmaceutical sector, which started to replace imported products with locally produced ones.

### **Project coordination**

Ethiopia was receiving a tremendous amount of development support from all over the world. The German-funded projects managed by GIZ and PTB were the prime change agents for the QI, and coordination was guided by the German federal ministry, the BMZ. Other development partners in Ethiopia were more involved in industry development projects or the modernization of legal and financial frameworks. Hence, the development partners set up a Donor Assistance Group (DAG), under which they sought to coordinate their assistance to the government of Ethiopia and share information on ongoing and planned activities.

The DAG was a committee at the head-of-agency level and was supported by a number of thematic working groups, including one for private sector development and trade, which met monthly and which dealt with the QI and issues such as value chain development, private-public dialogue, financial services, and intermediary organizations. Donor agencies active in this latter group were the EU delegation, GIZ, the ITC, JICA, the Embassy of the Kingdom of the Netherlands, the Swedish International Development Cooperation Agency (Sida), the UNDP and UNIDO, USAID, and the World Bank. It was especially the various industry development interventions that profited from these transparency efforts.

The university reform and TVET system (ECBP components 1 and 2) were embarked upon to provide Ethiopia with a new generation of well-educated engineers and technicians to spearhead the country's transformation from an agricultural society to an industrialized country. Even though the QI was not the prime reason for the university reform and establishment of a TVET system, the QI would benefit from both, and synergies between the projects of QI reengineering, the university reform, and TVET system were actively pursued—for example, through the establishment of QI-related curricula.

The PTB project and the ECBP component 3 (QI Reform) both provided much support for QI reform. They were both rolled out in two phases, each with a duration of about four years. The first phase of the ECBP was largely a

preparation phase, with some pilot projects to start the implementation. The second phase of the ECBP was earmarked as the main implementation phase—a scaling-up of the pilot projects—to realize the envisaged impacts. The PTB project was geared more toward technical capacity building than toward the overall reengineering of the QI, but its experts provided relevant international good-practice information at crucial times during the development of the QI strategy.

Because of the size of the project, GIZ established a country office in Addis Ababa, and many experts were engaged at any given time in the country. The Ethiopian side was well represented in the joint ECBP office, giving the project the Ethiopian focus envisaged from the beginning. PTB did not establish a country office during these years and used GIZ offices.

## STAKEHOLDERS AND THEIR ROLES

During the first phase of the ECBP, which was largely devoted to planning, the Ministry of Planning was the leading counterpart. This ministry had been established primarily to spearhead the massive civil service reengineering program of the Ethiopian government. The government therefore fully supported the Ministry of Planning, giving it extraordinary political powers to undertake the civil service reforms. Its powerful position was no doubt an authoritative influence in the reengineering of the QI. It was stood down after the major government reshuffling in 2010, and the counterpart of the projects became the Ministry of Civil Service.

Once the second phase of the ECBP was under way, many other stakeholders had to be considered in implementing the far-ranging plans for the ECBP's four components and PTB interventions. Hence, the Ministries of Education, Trade and Industry, Health, Agriculture, Urban and Works, and Science and Technology all had to be involved. The regions and private sector business associations also become important in coordinating the implementation of the wide-ranging, private sector-related elements of the projects. This brought about a certain amount of tension between the project management, the Ministry of Planning, and some of the other ministries as to who was in control of the overall project, no doubt exacerbated by the fact that the Ethiopian government was cofinancing the ECBP in no small way.

The private sector participated in the ECBP's annual customer satisfaction survey (Becker, Schäfer, and Diergardt 2012). This survey was broken down by priority sectors and company size. The overall survey results indicated a growing satisfaction with the service delivery of the four QI organizations created by the splitting up of the QSAE or of their predecessor departments within the QSAE. On a scale of 1 (not satisfied) to 6 (very satisfied), the compounded satisfaction indexes were as follows: 2.69 in 2007, 2.76 in 2008, 3.31 in 2010, and 3.71 in 2011. The 2011 indexes for the individual national QI organizations were as follows: 3.84 for the ESA, 3.52 for the ECAE, 3.86 for the NMIE, and 3.63 for the ENAO. This could be interpreted as indicating that about 60 percent of the customers were satisfied with the QI service delivery and that a lot of progress still had to be achieved.

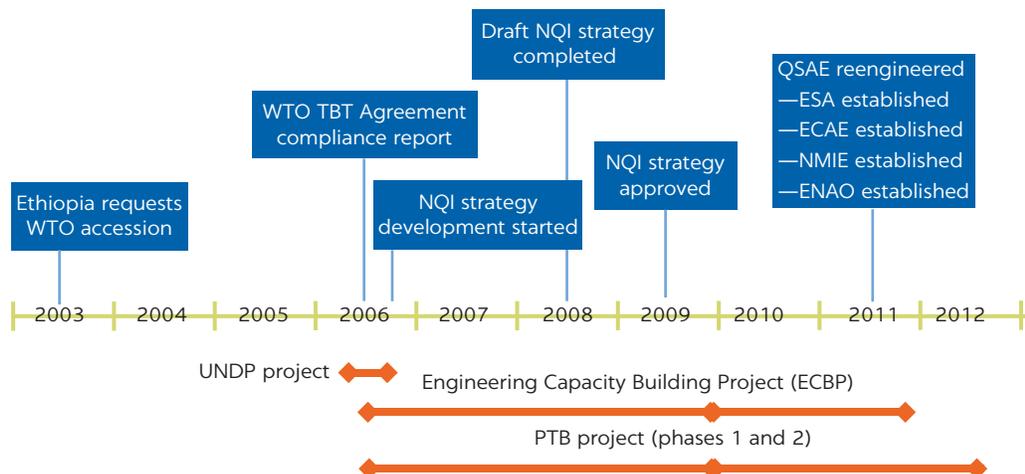
## OUTCOMES

The major results achieved in reengineering Ethiopia's QI (figure 1) and in getting the private sector to make better use of the higher-level QI service delivery are summarized below.

**Reengineering the QI.** Ethiopia's QI—largely represented by the QSAE, with its wholly integrated approach (standards, metrology, inspection, testing, product certification, registration of other laboratories, and the administration of mandatory standards) with its many conflicts of interest and total lack of international recognition—could be reengineered. The QSAE was split into four QI entities, each dealing specifically with an element of the QI, namely standards (ESA), metrology (NMIE), accreditation (ENAO), and a commercialized conformity assessment organization (ECAE). This brought about a much more focused management approach and business orientation. The four entities were placed under the Ministry of Science and Technology as part of the public science system of Ethiopia. All of them could become the recipients of further, more-focused development projects from development partners.

**Eliminating regulatory conflicts of interest.** The QSAE's regulatory activities were separated from the QI service delivery organizations. The administration of mandatory standards was placed in an independent regulatory agency under MoTI. The trade metrology activities were devolved to MoTI's trade inspectorates in each of the 11 regions. The conflict of interest was therefore set aside between, on the one hand, standards development, testing, and certification, and on the other hand, market surveillance and the imposition of sanctions regarding mandatory standards.

**FIGURE 1**  
Timeline of main QI project events and notable milestones, 2003–12



Note: ECAE = Ethiopian Conformity Assessment Enterprise. ENAO: Ethiopian National Accreditation Office. ESA = Ethiopian Standards Agency. NQI = national quality infrastructure. PTB = National Metrology Institute of Germany. QI = quality infrastructure. QSAE = Quality and Standards Authority of Ethiopia. TBT = Technical Barriers to Trade. UNDP = United Nations Development Programme. WTO = World Trade Organization.

**Establishing and accrediting QSAE-Cert.** A quality management system certification body, QSAE-Cert, was established to complement the product certification activities already in place. This service was accredited by DAkkS, thereby enabling international recognition of its certificates. In this way a major gap in QI service delivery at the national level was addressed, so industries requiring certification no longer had to use the services of expensive foreign certification bodies.

**Supporting standards-compliant laboratories.** Many laboratories in both the public and private sectors were supported to implement management systems in accordance with ISO/IEC 17025, and some of them could be accredited by ENAO or foreign accreditation organizations. The total lack of international recognition for the services of the Ethiopian QI was beginning to be addressed, even though a tremendous amount of progress still had to be achieved. The Ethiopian Laboratory Association was established to foster cooperation within the laboratory sector of the country.

**Modernizing tertiary education in technology.** As a fundamental for the future industrial development of Ethiopia, the university and technical college structures and curricula for technology education were totally revamped and modernized. Annual reviews of the employability of students in these new systems indicate that more than 90 percent of the academic students and at least 50 percent of the technical college students find appropriate employment (Becker, Schäfer, and Diergardt 2012). The expectation was that the rapid development of technology-centered industries would soon require more students in the near to middle future.

**Expanding and modernizing vocational training.** A modern vocational training system with training and examination centers in each of the 11 regions was established, in which 1,000 industries played a central role in providing internships for vocational training. The 14,000 trainers were evaluated, trained, and reevaluated to ensure a common high standard of vocational training aligned with international good practices.

**Improving industrial export markets.** Exports and formal employment in selected industrial sectors have risen. Ethiopia has become, since 2005, through the services of the QI, an increasingly attractive production and investment location in the textile and leather sectors on the African continent. The Ethiopian pharmaceutical sector has increasingly substituted previous drug imports. But challenges remain concerning the broader framework conditions for private sector development; specifically, private enterprise growth and financial service availabilities did not improve much.

## PROBLEMS ENCOUNTERED: CHALLENGES AND ISSUES

Despite the many successes achieved in reengineering the Ethiopian QI and related activities, serious challenges were also encountered, mostly related to the projects' size and complexity.

**Management clashes between partners.** Although the Ethiopian government's substantial contribution in terms of finances and manpower supported the development projects admirably, it also meant that there was friction regarding the overall management of the process, with micromanaging tendencies of the Ethiopian partners often clashing with development partners' processes and procedures.

**Second-phase implementation differences between ministries.** The powerful political position of the Ministry of Planning and its mandate from the government to reengineer the whole of the civil service helped to overcome opposition and to get the reengineering process under way during the first phase. However, this unique construct between the development partners and the Ministry of Planning was seriously tested during the second phase that started in 2009, when many of the changes had to be implemented. The responsible ministries in which the changes were realized—such as the Ministry of Science and Technology, MoTI, and Ministry of Education—sometimes had differing approaches and priorities. There was no agreed-upon joint action plan, and differences of opinion and priorities surfaced continuously during the second phase of project implementation. Because of the flexibility of the project planning, these differences could be addressed, but doing so took resources that could have been used to better effect elsewhere.

**Culturally based tensions between local and foreign participants.** The massive use of German- and Ethiopian-funded international experts, combined with the parallel development of many of the systems, accelerated the Ethiopian development process. On the other hand, this influx of many foreigners into the country resulted in friction between the locals and foreigners—both sides not fully understanding or appreciating the differences in culturally based political thinking and management custom and practice. This had a negative impact on some of the program results.

**QI program delays within nationwide civil service reforms.** The huge and complex countrywide civil service reform programs took years longer to plan and implement than envisaged, and because the QI's reengineering was subsumed into this program, it took much longer to get the reengineering started than was anticipated in project planning. Hence, some of the planned interventions could only be started and not completed, and some could not even be started (such as in trade metrology).

**Inadequate staff continuity.** High staff turnover in both the ECBP head office and in many of the partner institutions, such as academic and technical universities, had a negative impact on the continuity of project implementation. The same applied to the Ethiopian experts trained in quality management or auditing techniques. Soon after being trained, they left their respective institutions for better employment opportunities elsewhere, depriving said institutions of the required skills to advance the recognition of their technical capabilities, such as through accreditation.

**Recruitment of international experts with limited experience.** Because of the vast number of experts required for this enormous and complex project, the development partners could not always obtain the services of appropriately

qualified international experts and had to make do with less-experienced people. This was quickly picked up on by the Ethiopian side, with negative consequences for the project's implementation, in that the input of these experts was not always readily accepted.

## KEY SUCCESS FACTORS AND LESSONS LEARNED

Obviously, some key success factors ensured that the reengineering of the Ethiopian QI was realized. Some of them were considered in project planning; others were more of a fortuitous nature. The most apparent success factors are summarized here.

**Strong political leadership.** A fundamental reengineering of long-established organizations such as the QSAE will always trigger resistance. In the case of the QSAE, it was not only the organization's separation from regulatory work (which would have been a hurdle regarding income); it was also the splitting of the organization into four separate entities that was the biggest challenge. A strong political will and clear leadership to implement such a change is an absolute necessity, because it is highly unlikely that a public entity will willingly undergo such radical transformation by itself. In the case of Ethiopia, the mandate and powerful political influence of the Ministry of Planning was of crucial importance for the fundamental reengineering of the country's QI.

**Export sector demand for QI services.** The creation of demand for QI services—for example, supporting enterprises to get their products tested and certified as well as becoming certified for ISO 9001, ISO 14001, and other quality management systems—is important to initiate the long-term financial sustainability of QI service providers. A focus on the export sectors brings more dividends than supporting those enterprises that only operate in local markets. Local market purchasing power is frequently too low to be able to leverage product quality; price is still the driver for local purchases.

**Well-educated technical personnel.** The establishment of appropriate educational programs at tertiary education establishments is of vital importance to ensure a continuous and plentiful supply of appropriately educated technical staff for QI organizations and industry, once the few project-related training programs have been completed and the project has come to an end. Such a plentiful supply will also somewhat deter trained individuals from excessive job-hopping, commanding higher salaries as they go along. It is especially the public sector institutions that would benefit from such a situation; to some extent, the private sector, with its more attractive remuneration systems, will become saturated.

**Generous knowledge sharing from development partners.** The transparent way in which the many development partners in Ethiopia shared their development programs with each other was important in successfully reengineering the Ethiopian QI. The number of these programs, each with its own focus but overlapping in many areas, could have quickly led to major tensions among the members of the donor community and their Ethiopian partners. The Head of Mission

meeting, supported by thematic subcommittees, provided the appropriate platform for sharing information without demanding coordination. Yet coordination did happen voluntarily as the development partners flexibly adjusted their programs for the greater good of Ethiopia.

## CONCLUSION

Reengineering the QI of a country is always a challenge, one that is all the greater if the national standards body, like the QSAE, follows a fully integrated approach. The splitting of the QSAE into four independent organizations, each with its specific QI focus, is commendable. It took serious political will from the Ethiopian government to undertake this major reengineering process.

The major developments of the university and the vocational training systems will not only provide industry and the authorities with appropriately trained technical people for the future but will also benefit the QI in no small way. The investment in industry, still ongoing, to establish it as internationally competitive will bring dividends in the medium to long term. Internationally accepted QI will be one of the key features of this ambitious project to change Ethiopia's largely subsistence-agriculture-based business environment into a modern, industrialized one.

## NOTES

1. ISO 9001:2015, "Quality Management Systems—Requirements": <https://www.iso.org/standard/62085.html>.
2. ISO 14001:2015, "Environmental Management Systems—Requirements with Guidance for Use": <https://www.iso.org/standard/60857.html>.
3. For information on the current status of Ethiopia's accession to WTO membership, see the WTO's Ethiopia status page: [https://www.wto.org/english/thewto\\_e/acc\\_e/a1\\_ethiopia\\_e.htm#status](https://www.wto.org/english/thewto_e/acc_e/a1_ethiopia_e.htm#status).
4. In quite a few low- to middle-income economies, the national product certification mark is a prerequisite for demonstrating compliance with mandatory standards. Whereas a mandatory standards system may still be compliant with the technical regulation requirements of the WTO TBT Agreement, the use of the national product certification mark as the demonstration of compliance of the product is considered an unnecessary trade barrier and as a license for the national standards body to extract rent. Economies that still practice such a system should seriously consider changing to a more trade-friendly system.
5. ISO/IEC Guide 65:1996, "General Requirements for Bodies Operating Product Certification Systems," has been superseded by ISO/IEC 17065:2012, "Conformity Assessment—Requirements for Bodies Certifying Products, Processes and Services": <https://www.iso.org/standard/46568.html>.
6. Least-developed countries (LDCs) are low-income countries confronting severe structural impediments to sustainable development. They are highly vulnerable to economic and environmental shocks and have low levels of human assets. There are currently 47 countries on the list of LDCs, which is reviewed every three years by the United Nations (UN) Committee for Development (CDP), a subsidiary body of the UN Economic and Social Council.
7. At the time of the ECBP project, this was known as the German Agency for Technical Cooperation (GTZ), one of multiple German development organizations. The BMZ merged many of these along the way, renaming them collectively GIZ.
8. ISO/IEC 17025:2005 has been superseded by ISO/IEC 17025:2017, "General Requirements for the Competence of Calibration and Testing Laboratories": <https://www.iso.org/standard/66912.html>.

9. “Kaizen,” Japanese for “improvement,” refers to a Japanese business philosophy of continuous improvement of working practices and personal efficiency to increase productivity and eliminate waste.
10. A “bonded factory” is a factory officially licensed by the government to store imported goods and use them in manufacturing without paying tax for importing the goods until they leave the factory.

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