Asia-Pacific
Economic Cooperation

Advancing Free Trade
for Asia-Pacific **Prosperity**

Developing Indicators to Assess the Strength of Standards and Conformance (S&C) Infrastructure in APEC

APEC Policy Support Unit

April 2018

Prepared by:
Ben Shepherd (Principal) and Anna Markitanova (Consultant)*
Developing Trade Consultants.
Ben@Developing-Trade.com.

Akhmad Bayhaqi, Emmanuel A. San Andres and Denise Cheok
Asia-Pacific Economic Cooperation Policy Support Unit
Asia-Pacific Economic Cooperation Secretariat
35 Heng Mui Keng Terrace
Tel: (65) 6891-9500 Fax: (65) 6891-9690
Email: psugroup@apec.org Website: www.apec.org

Produced for:
Asia-Pacific Economic Cooperation
Sub-Committee on Standards and Conformance

APEC# 218-SE-01.4

* The respective authors are writing in a strictly personal capacity. Any views expressed are those of the authors only and do not represent the views of any organisations with which they are affiliated or the views of any Officials of those organisations.

The authors would like to thank Rhea Hernando, Tammy Hredzak and Aveline Low for their extensive support in drafting the case studies. Excellent research assistance from Satvinderjit Kaur Singh is also acknowledged. The views expressed in this paper are those of the authors and do not necessarily represent those of APEC Member Economies.

TABLE OF CONTENTS

LIST OF FIGURES

LIST OF TABLES

LIST OF BOXES

1. EXECUTIVE SUMMARY

Developing stronger standards and conformance (S&C) infrastructure assists in pursuing APEC's agenda of trade facilitation by reducing bilateral trade costs. With the rise of GVCs, it becomes even more pertinent to comply and harmonise with standards in production and distribution networks. This paper aims to analyse the strength of standards and conformance infrastructure in the region. To do this, surveys were completed by member economies and six case studies were conducted on Australia, China, Japan, Peru, Singapore and Viet Nam.

Standardisation is an important part of an economy's quality infrastructure. It consists of three layers, a body of technical experts writing the standards, a conformity assessment ensuring that goods and services are conforming to relevant standards, and an audit system making sure of the effectiveness of the conformity assessment.

A dashboard was created covering some aspects of the questionnaire. It has a list of indicators to assess S&C infrastructure which can be tracked over time. The indicators included are:

- Indicators of the existence and the key elements of S&C infrastructure
- Indicators of economies' participation in international and regional S&C bodies
- Percentage of economies' national standards that are aligned with international standards, by major sector
- Percentage of economies that report having a system to track consumer and business awareness as well as confidence in S&C
- Percentage of economies that have a process to develop standards based on future needs
- Percentage of economies that engage in outreach programs in relation to S&C

The surveys and case studies show that APEC economies are in general active in international and regional S&C bodies. However, the level of involvement is higher among the developed economies. APEC's overall alignment with international standards like ISO, IEC, and APMP is strong. Most of the economies are developing processes to create standards that adhere to future needs and are also conducting outreach programmes to increase the knowledge on S&C.

In addition to this area, the report has identified the following types of data points that could be further collected (e.g., through representative surveys):

- Number of firms with ISO quality/IEC certification per 100,000 firms.
- Estimated price premium (in percentage) that can be charged if a product is certified (where that is optional and not mandatory for safety reasons).
- New national standards and accreditation programmes that have been introduced in the last year, broken down by sector.
- Average time taken to develop a new national standard.
- Number of MSMEs involved in SDOs and standards outreach to SMEs.

The case studies concluded that business uptake of S&C varied across firms and economies. Nevertheless, interviewees from all economies agreed that there was a strong rationale to increase standards adoption, particularly for firms entering GVCs as they depend heavily on standardised goods and services. Many also note the need to remain innovative and plan for future developments, especially in the areas of services, cybersecurity, and other internet technology.

2. INTRODUCTION AND PROJECT OVERVIEW

OBJECTIVE OF THE STUDY

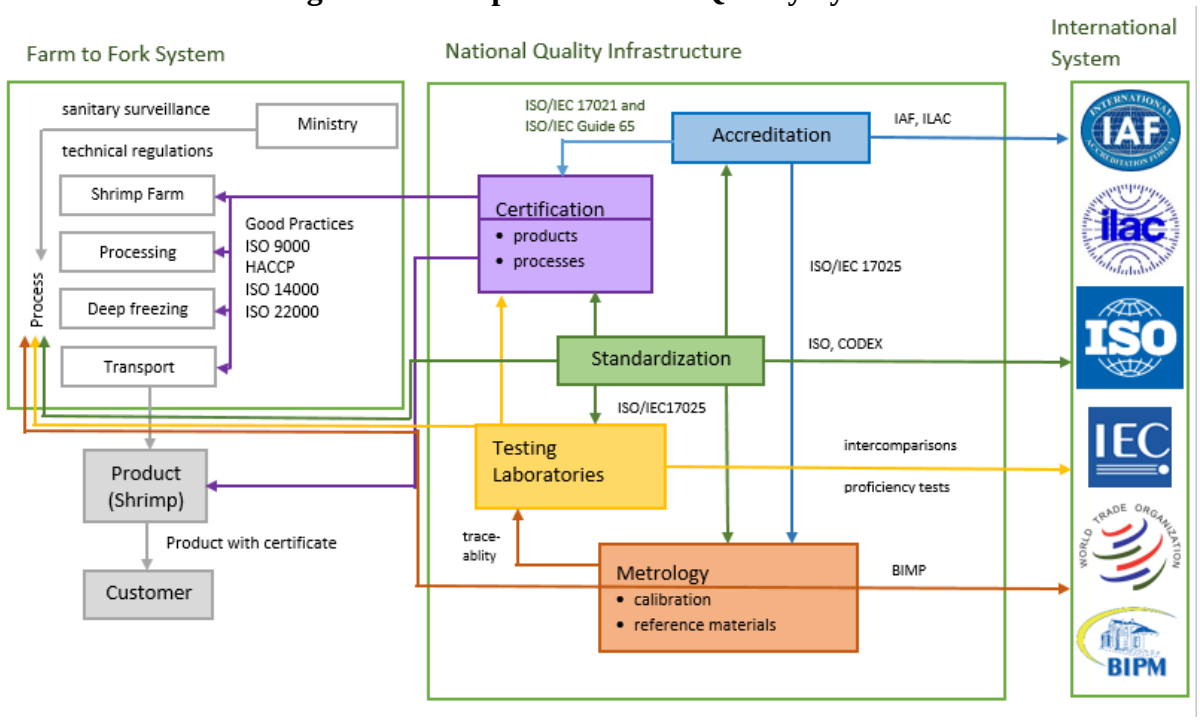
The subject of this study—developing indicators to assess the strength of standards and conformance (S&C) infrastructure in the region—is a very important one for APEC member economies. In particular with the rise of global value chains (GVCs), standards loom large as the gatekeepers of market access: low tariffs are not enough to provide effective market access, particularly to smaller firms; it is also necessary to comply with mandatory and voluntary standards in order to be fully integrated into production and distribution networks.

S&C has traditionally been part of APEC's trade facilitation agenda, as it is one way of reducing bilateral trade costs within the region. However, the issue is now increasingly gaining prominence in its own right through the framework of national quality infrastructure. That concept refers to the full range of institutions that combine forces to support the private sector in producing safe, fit-for-purpose, and high-quality goods, and increasingly services.

Standardisation is only one part of the national quality infrastructure. Many other institutions are also involved, including metrology, accreditation, testing, and certification. Hufbauer, Kotschwar and Wilson (2001:10) describe standards infrastructure as a system consisting of several layers: (1) body of technical experts (a government agency, a private trade association, and international fora) that writes the standard; (2) conformity assessment: mechanism for assuring that goods and services that claim to meet the relevant standard actually have met the standard; (3) accreditation and recognition system: audit system that ensures that conformity assessment is effective.

The figure below sets out a typical national quality infrastructure setup from an upper middle or high income economy; lower income economies typically only have some parts of this infrastructure in place, which hampers their ability to access high standard markets, and access GVC networks that rely on highly standardised intermediate inputs for their production model.

Figure 1: Example of National Quality System



Source: Adapted from Sanetra and Marban (2007).

A number of other elements are also necessary to ensure that the quality system works well and is effective in achieving its goals of improving the quality and consistency of production. On the one hand, testing laboratories are needed to assess whether or not a given product complies with a particular standard (conformity assessment). Those laboratories need to be accredited by a competent agency, which certifies that they comply with the relevant standards governing conformity assessment. Conforming products are often entitled to certification, or application of a mark to their goods, so that consumers can easily distinguish conforming and non-conforming goods. Finally, there needs to be a metrology organisation to ensure that measurement is conducted using appropriate instruments, and is performed to an acceptable level of accuracy. Figure 1 above presented one overview of the way in which these organisations can work together with a national standards body—which issues standards—to ensure high-quality production.

Good S&C Infrastructure supported by strong governance and institutions will provide efficient services for enterprises, enabling these firms to upgrade themselves and to provide better products for customers.

Indeed, building a good Quality and S&C infrastructure needs significant resources, both time and finances. Table 1 below provides some rough estimates of costs and time involved in developing adequate components of Quality Infrastructure.

Table 1: Estimated Costs and Time Involved in Developing Quality Infrastructure

Component	Investment cost (US$ millions)	Development time for harmonisation (years)
National metrology institute	5–200	15
Legal metrology	0.5–5	5
Secondary calibration and testing laboratories	2–500	2–15
National accreditation body	0.5–2	5
National standards body	0.5–2	5

Source: Racine and Tippmann (2013).

While it may seem costly, having good standards, testing and inspection infrastructures could bring tangible benefits to business. UNIDO (2015) noted that by having a product tested/inspected by an internationally recognised accredited laboratory will provide benefits to firms because it:

- Increases the speed at which goods pass through the border
- Ensures conformity assessment certificates are accepted on both sides of the border
- Reduces rejections of goods at the border
- Minimises the opportunity cost
- Cuts trading costs for private sector, making them more sustainable.

GENERAL FRAMEWORK AND APPROACH

The approach to this assignment is to embed S&C in the broader context of national quality infrastructure. The rationale for proceeding in this way is that all APEC economies are committed to consistently raising quality in a wide range of industries, so it is important that the project addresses the full range of standards-related issues that go into this process.

This Report presents results and conclusions from the study. It first reviews the relevant literature and discusses methodology. It then presents results from a survey of member economies, conducted through the Sub-Committee on Standards and Conformance (SCSC). Next, it presents a set of case studies from member economies. The survey and the case studies will serve as instruments to develop indicators to assess the strength of S&C infrastructure in APEC. The final section concludes by consolidating the insights gained from these new inquiries and discussing policy implications.

3. LITERATURE REVIEW

This section introduces key results from the literature on standards on trade, then zooms in to look at more details at the way these issues have played out in the APEC context by identifying key documentary milestones in APEC's S&C work.

QUALITY INFRASTRUCTURE AND TRADE

Standards Regulatory Environment

Standards are documents setting out requirements that products, services, or systems must meet in order to be considered as conforming. Conformity to a standard delivers a benefit in the marketplace, as it signals to the consumer or other user that goods, services, or a company's systems are of a particular level of quality and consistency. The term standards is a broad one, covering mandatory and voluntary standards, whether they are issued by a public or private body.

Historically, each economy has issued its own standards through their own standards bodies, some of which are public sector entities, and some of which are private sector associations. The trend in the developed world is increasingly towards letting the private sector decide on its own standards, except in core areas of regulatory competence such as health, consumer protection, and the environment. Standards designed to meet other needs—such as interoperability of electronic products—are typically a private sector affair.

Another distinction in the standards literature is between mandatory and voluntary standards. A company must comply with mandatory standards before it can sell its goods in a particular market. By contrast, it is free whether or not to comply with voluntary standards from a legal standpoint, even though compliance may be a commercial necessity, particularly when dealing with large distributors (wholesalers and retailers), which need products of consistent characteristics and quality. Again, there is a clear trend among developed economies towards the use of voluntary rather than mandatory standards, because the former leave greater scope for innovation in the marketplace, and are less cumbersome to update and reform than mandatory standards. So the domain of application of mandatory standards has, in the developed economies, typically shrunk to cover core aspects of health, safety, and consumer protection.

Historically, most standards production has taken place domestically, through economy-level standards agencies. The result has been differing standards, sometimes for sound scientific or environmental reasons, other times simply because of a past accumulation of practice in the marketplace, or historical issues of regulatory design and approach. Divergent standards in economies add to the costs faced by business, as exporters need to retool and redesign so that their products meet relevant standards in all markets where they operate. The costs can be high, particularly for exporters in developing economies—high enough to keep them out of markets where they might otherwise be competitive. For example, Czubala et al. (2009) show that standards represent a significant barrier to developing economy exports of textiles and clothing products to the EU market, and Shepherd and Wilson (2013) find a similar result for the case of agricultural products. Both sectors are of particular importance to developing economies in

the early stages of industrialisation, which highlights the importance of product standards as a development issue.

It is important to stress that product standards add to both the fixed (paid once) and variable (per unit) costs associated with international trade. Variable cost increases are due to the need for testing and certification, while the investment costs required to redesign a product line to meet a foreign standard can be substantial, even though they are only paid once. In addition, the fixed costs associated with product standards in overseas markets can be particularly high in developing economies, where technical expertise may not be easily available. Shepherd (Forthcoming) shows that product standards in developed economy markets can limit the ability of developing economies to diversify their export base because of these kinds of fixed cost issues that impede the ability of firms to introduce new products.

As a result of these factors, divergent standards have therefore come to be seen as a potential source of trade costs in some cases, and thus as a friction that typically tends to hold back global trade. It is important to highlight that in the vast majority of cases, the aim of a standard is not protectionist. Rather, it is the achievement of a valid regulatory objective, like consumer protection, or protection of the environment. What is emphasised here is the economic effect of the instrument used: the result can be de facto market protection, even when that is not at all the aim of the standard.

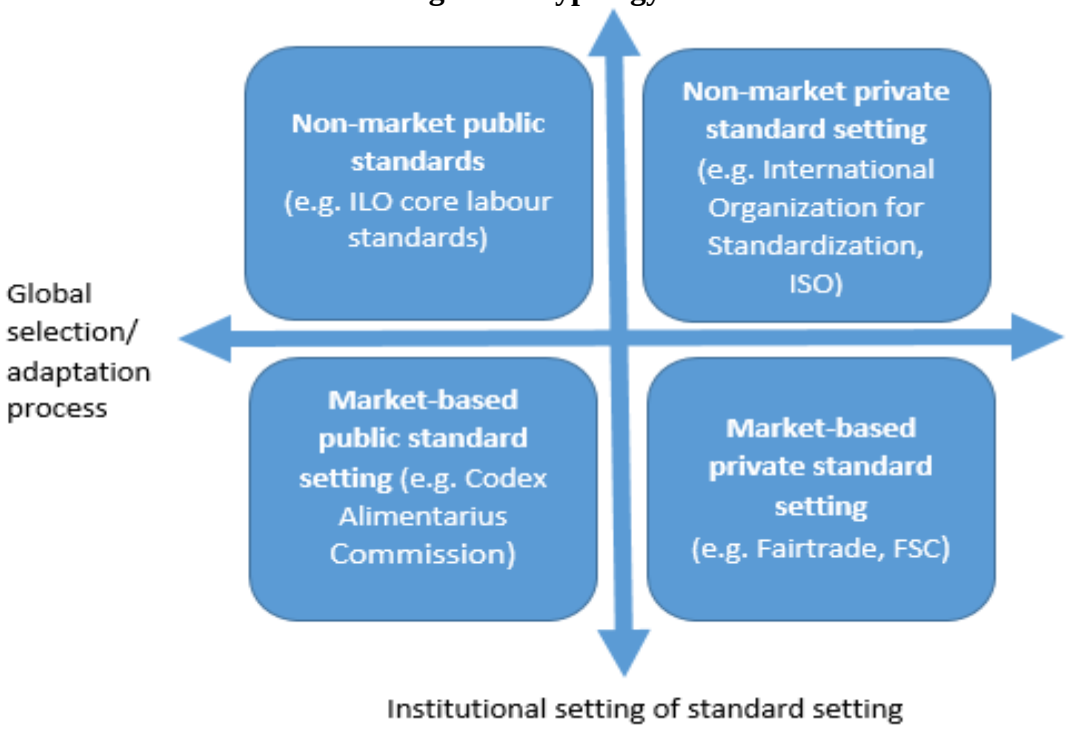
Although protectionist measures like tariffs raise trade costs in a way that can be analogous to some of the effects of product standards, the policy issues that arise in the two cases are quite different: economic logic suggests that tariffs should typically be lowered in order to increase welfare and facilitate market access for exporters; by contrast, standards should not necessarily be "rolled back" in all cases, as their regulatory objective may be valid and important. The issue is therefore how best to design and implement standards so that the benefit/cost ratio is maximised. Typically, this approach means ensuring that standards are not unduly costly to comply with, and represent the most efficient way possible of achieving a given regulatory objective. This approach lines up well with APEC's ongoing attention to issues of regulatory cost and benefit within the broader issue area of good regulatory practice, and regulatory impact assessment.

In the landscape of standards setting, there are myriads of standards that vary in scopes, requirements, and implementation and verification policies (ITC 2011). Büthe and Mattli (2011) in ITC (2011) suggested the following typology of standards[1]:

- Public nonmarket-based standards collaboration of intergovernmental organisations or cooperation among domestic regulators.
- Public market-based standards result from market-like competition between public regulatory agencies of individual states or regional and multilateral standard setting bodies.
- Private nonmarket-based standards by private bodies dominating one or several sectors.
- Private market-based standards by firms or any other body, such as NGOs, research institutes, multi-stakeholder coalitions/roundtables and industry associations.

[1] ITC (2011) noted that "the distinction between these four types of standards is not always straightforward and there are cases where a clear distinction is difficult". For reference of several definitions of private standards please refer to WTO (2014).

Figure 2: Typology of Standards



Source: Büthe and Mattli (2011) in ITC (2011).

Harmonisation of Standards

One way of dealing with the trade difficulties linked to divergent national standards is to harmonise, i.e. adopt the same standard for two economies or a group of economies. The use of international standards is a special case of harmonisation with a wide group—in theory, all of the world that agrees to be part of the international harmonisation effort. Under a harmonisation strategy, compliance with a single standard gives a firm the ability to access all markets in the harmonisation zone. There is substantial empirical evidence that harmonisation of product standards lowers trade costs, with consequent gains for exporters: they can export more of existing products, and introduce new products into foreign markets (Czubala et al., 2009; Shepherd and Wilson, 2013; and Shepherd, Forthcoming).

APEC's approach to overcoming the costs associated with divergent standards has been to focus on regional alignment with international standards, which leverages the mechanisms set out here to reduce costs and provide maximum market access, while still ensuring that important public policy objectives are met.

There is no single body that issues international standards. Rather, a number of organisations are active in the area. The most well-known is the International Organization for Standardization (ISO), which has consensus-based processes and issues standards in a wide variety of areas. For electrical and electronic goods, International Electrotechnical Commission's (IEC) standards are a commonly used benchmark, again with wide-ranging consultative processes, but a more limited sectoral scope than ISO. Finally, the Codex issues food safety standards that are used as the basis of national standards in many economies, making it another agent of international harmonisation of standards.

Conformity Assessment and Metrology

In addition to standards bodies, a range of other organisations are also involved in quality infrastructure, with corresponding implications for international trade. Key examples include metrology and accreditation bodies, as well as testing laboratories and certification bodies (commonly referred to as 'conformity assessment bodies'). Efficient operation of these bodies supports high quality domestic production, and facilitates trade through transparency and lower trade costs. However, the trade effects of improvements to the functioning of these bodies is hard to quantify[2].

As standards, conformity assessment, and metrology are inter-linked with one another, in the literature, they are sometimes being regarded as simply 'standards system'. Hufbauer, et. al. (2001), in defining 'standards infrastructure', suggests that standards system is a type of soft infrastructure containing the following layers (p.10):

i. Body of technical experts (a government agency, a private trade association, an international forum) that writes the standards.
ii. Conformity assessment: the mechanism for assuring that goods and services that claim to meet the relevant standard do in fact live up to the claim.
iii. Accreditation and recognition system: the audit system that ensures that conformity assessment is working properly – that errors are kept within an acceptable level of tolerance.

As is the case for standards, there are also international bodies or organisations that deal with metrology[3] and accreditation, such as BIPM, OIML, IAF, and ILAC. These international bodies interact with domestic bodies to produce the overall quality system within which international trade takes place. Organisations such as ILAC, APLAC, PAC and IAF also have MRAs or MLAs under them to facilitate the acceptance of traded products across borders (see Table 2). Standards Council of Canada (2003) highlighted the following benefits of MRAs and MLAs:

- Support for mutual acceptance of test, inspection and certification arrangements
- A reduced need for re-inspection, re-testing and re-certification of products
- Supports international acceptance of test and measurement data.
- Underpins MRA agreements between governments for mutual acceptance of test, inspection and certification arrangements.
- Ensures that the accreditation programs of signatory economies are re-evaluated regularly against the best practices of the international community.

[2] WTO (2005:57) noted that the issue of conformity assessment has received relatively little attention in the theoretical economic literature; perhaps because conformity assessment can be modelled in a relatively straightforward way as an additional transaction cost of exports.

[3] Metrology services such as establishment of measurement procedures and ensuring calibration of measurement instruments support other Quality Infrastructure services (such as testing, inspection, certification, and accreditation) as they rely on accurate measurements (Gonçalves and Peuckert, 2011).

Table 2: MRAs and MLAs under ILAC, APLAC, PAC and IAF

	Number of Signatories	Number of Economies	Scope
ILAC	91	95	Testing ISO/IEC 17025: 88 bodies Calibration ISO/IEC 17025: 74 bodies Inspection ISO/IEC 17020: 61 bodies Testing ISO 15189: 55 bodies
APLAC	37	24	Testing ISO/IEC 17025: 35 bodies Calibration ISO/IEC 17025: 27 bodies Inspection ISO/IEC 17020: 19 bodies Medical ISO 15189: 17 bodies RMP ISO Guide 34: 14 bodies PTP ISO/IEC 17043: 11 bodies
PAC[4]	24	20	Management Systems ISO/IEC 17021-1: 57 bodies Product ISO/IEC 17065 / GAP: 27 bodies GHG Validation Verification ISO 14065: 6 bodies Persons ISO/IEC 17024: 3 bodies
IAF	63	58	QMS Certification Bodies ISO/IEC 17021: 57 bodies EMS Certification Bodies ISO/IEC 17021: 53 bodies FSMS Certification Bodies ISO/IEC 17021: 12 bodies ISMS Certification Bodies ISO/IEC 17021: 4 bodies Product Certification Bodies ISO/IEC 17065: 56 bodies Global G.A.P. IFA CPCCs: 30 bodies Personnel Certification Bodies ISO/IEC 17024: 23 bodies

Source: http://www.nite.go.jp/en/ and http://www.apec-pac.org/

APEC's work under conformity assessment includes the Mutual Recognition Arrangement for Conformity Assessment of Telecommunications Equipment (APEC TEL MRA) and the Electrical and Electronic Equipment Mutual Recognition Arrangement (APEC EEMRA). APEC TEL MRA is intended to streamline the Conformity Assessment Procedures for a wide range of telecommunications and telecommunications-related equipment and to provide for mutual recognition by the importing Parties of Conformity Assessment Bodies and mutual acceptance of the results of testing and equipment certification procedures undertaken by those bodies in assessing conformity of equipment to the importing Parties' own Technical Regulations (APEC 1998). There are several phases for the implementation of APEC TEL MRA: 1.) The mutual recognition of test reports. 2.) Recognition of certification of telecommunications products. 3.) Mutual Recognition Arrangement for Equivalence of Technical Requirements (MRA-ETR): builds upon the MRA for Conformity Assessment by facilitating the recognition of equivalent standards or technical requirements[5].

The APEC EEMRA has three parts[6]:

- Part I: Information interchange: providing information about mandatory requirements on regulated electrical and electronic products in a standardised format to assist those in other APEC Member Economies who may wish to export electrical and electronic products to that economy.
- Part II: Acceptance of test reports: commits participating APEC Member Economies to mutually accept test reports produced by testing facilities designated by participating

[4] APLAC and PAC would be merged to establish the Asia Pacific Accreditation Cooperation (APAC) in 2019.
[5] Source: http://www.apec.org/Groups/SOM-Steering-Committee-on-Economic-and-Technical-Cooperation/Working-Groups/Telecommunications-and-Information/APEC_TEL-MRA.aspx and APEC TEL MRA – Guide for Industry Version 1.0 - July 2001.
[6] Source: http://www.apec.org/Groups/Committee-on-Trade-and-Investment/Sub-Committee-on-Standards-and-Conformance/apec_eemra.aspx

economies in accordance with the designation requirements of the EE MRA which are in accordance with the relevant ISO/IEC Standards and do not require re-testing.

- Part III: Acceptance of certification: commits a participating importing APEC economy to accept product certification (including batch testing) produced by certification bodies designated by participating exporting economies in accordance with the designation requirements of the EE MRA.

Member Economies' Participation in Standards and Conformance Bodies

Annex 1 to this Report provides some first evidence on the ways in which APEC economies interact with the international standards system, and an overview of one way in which that information can be summarised quantitatively. In most cases, membership is indicated with a one, and non-membership with a zero. Intuitively, summing or otherwise summarising these scores makes it possible to summarise performance across a number of dimensions.

As the table shows, membership in these bodies is virtually universal within APEC. However, it is important to go behind these data to look more in detail at the ways in which economies interact with these bodies in concrete terms. To do this, the columns for ISO and IEC provide additional information on the number of committees within those organisations that APEC economies are members of. Active participation in these technical bodies is very important, in an effort to ensure that international standards respond to the needs of a diverse range of economies. Taking the example of ISO, there is clearly great variance in the extent to which APEC economies are able to actively take part in its standards development activities: some economies are only involved in a handful of technical committees, while others are involved in 700. In general, developed economies are members of more technical committees than developing economies, although large economies in the developing group also have the resources to support broad-based participation. A similar pattern is apparent, though not as starkly, in the case of IEC. The general point to take away is that there is scope for economies to use APEC, a forum in which they all participate, to help support some degree of supportive coordination and collaboration on standards. However, as a long-term proposition, it will clearly be important for the global community to mobilise technical and financial resources to support the enhanced participation of developing economies, particularly smaller ones, in the work of international standards bodies.

Many developing economies experience difficulties in taking part in the work of international standardisation bodies, due to lack of technical expertise and financial capacity. In some cases, assistance is available, but developing economies typically participate to a lesser degree in international standardisation efforts than do their developed counterparts. This asymmetry can give rise to an impression that international standards are made to suit developed economy conditions, and may not necessarily be applicable to the very different environments that prevail in developing economies. It is important for all economies to support broad-based and diverse participation in global and regional standards bodies, an issue we return to in the next section.

Regional bodies are also relevant to the standards agenda (see Maur and Shepherd, 2011 for a review), and APEC has long been aware of this importance, as evidenced by its engagement with regional standards bodies, not limited to organisations that issue standards, but also covering metrology and accreditation. In addition, many new generation regional trade agreements (RTAs) contain provisions on standards.

Annex 2 repeats the quantitative analysis for regional standards bodies. At this stage, information is only available on membership, not participation in subsidiary bodies. The table shows that membership of the key regional standards bodies is close to universal among APEC member economies. This finding is important, as it suggests that the regional infrastructure to support concerted movement forward on reducing standards-related trade costs is present and being used effectively.

APEC'S WORK ON STANDARDS AND CONFORMANCE: KEY MARKERS

APEC economies have shown leadership in the S&C area, in particular through an ongoing commitment to international and regional standardisation activities. Without limiting the many areas in which APEC and member economies have been active, this section gives a selective overview focusing on key documents that have been issued over the last decade and a half. As appropriate, we bring in documents from bodies with which SCSC has a collaborative and mutually reinforcing relationship, to highlight how S&C initiatives have been promoted in the broader Asia-Pacific over recent years.

APEC Information Notes on Good Practice for Technical Regulation (2000)

This document provides APEC member economies with resource materials for reference when preparing, adopting or reviewing their regimes for the regulation of products according to the Principles and Features of Good Practice for Technical Regulation compiled by SCSC.

It is recognised that whilst regulation will continue to be an important tool for preserving and advancing public interests, it can become an obstacle to achieving the very economic and social well-being for which they are intended, therefore the APEC member economies are encouraged to adopt the least restrictive regulatory response possible to achieve their legitimate regulatory objectives.

It is suggested that policymakers undertake cost-benefit analysis as a useful tool in whether a particular regulatory response is the most appropriate in a given situation. A major consideration when undertaking a cost-benefit analysis is the assessment of risk. It is also advised that the APEC member economies have mechanisms for the on-going evaluation of the effectiveness of the chosen regulatory response.

It is suggested that APEC member economies adopt performance-based technical regulations that provide flexibility, rather than prescriptive technical regulations that focus attention on only one means of achieving the desired objective.

The paper also refers to any general consumer protection or product liability regimes based in either legislation or civil law as 'regulatory safety nets'. In the absence of a strong regulatory safety net, governments may consider it necessary to adopt a more interventionist approach such as mandatory pre-market conformity assessment regimes with stringent post-market surveillance techniques to ensure that there is no possibility of non-compliant products entering their market. Where regulatory safety nets are strong, however, governments can adopt more light-handed approaches to product regulation, such as listings and supplier's declarations.

The paper highlights that the assessment of products after they have been placed in the market (known as a post-market surveillance regime) is the integral part of many conformity assessment regimes and provides for two essential characteristics of effective post-market surveillance regimes:

- Significant penalties for non-conformity. Levels of penalties depend on the seriousness of the safety hazard, the quantities that the product is supplied in, whether the supplier's conduct is blatant; and the level of cooperation from the supplier; however, as a practical matter it can be difficult to enforce penalties, in particular when suppliers may be distant from an economy and supplying through web-based platforms;
- An expectation by suppliers that non-compliant products will eventually be detected. Detecting non-compliance can be based on (i) the risk management approach, (ii) complaints-based approach.

Blueprint APEC Sub-Committee on Standards and Conformance (SCSC) (2005)

The document provides an overview of the Committee's work undertaken since its establishment through 2005, mainly, in the following areas:

1) The alignment with international standards that helps facilitate trade by the reduction of negative effects due to differing standards. It happens on 3 levels: (i) the voluntary level, where companies could state that their products are produced according to certain specifications contained in a standard; (ii) the mandatory level, where regulations should be based on international standards as appropriate according to the obligations set out in the TBT and SPS agreements; and (iii) the conformity assessment procedures, which can be employed to provide assurance of conformity to voluntary standards or government-mandated regulations.

2) Participation in international standardisation, which SCSC has encouraged through:

- Creation of Technical Groups (TG), which aim to coordinate regional input into the development of international standards on: Further improving the knowledge of member economies on specific standardisation subjects and on the standardisation process itself through capacity building activities;
- Encouraging Member Economies to become "P" Members of relevant ISO committees (with the right to vote);
- Encouraging participation in international standardisation.

3) Recognition of conformity assessment in regulated sectors:

- MRA - APEC MRA on Conformity Assessment of Foods and Food Products (1996), APEC MRA for Exchange of Information on Toy Safety (1996), APEC MRA for the Exchange of Information on Food Recalls (1999), APEC MRA on Conformity Assessment of Electrical and Electronic Equipment (1999), APEC MRA on Conformity Assessment of Sectoral Food.

MRAs are initiatives agreed by all SCSC Members as a way to contribute to trade facilitation, however economies participate in the MRAs only if they are ready and willing to do so.

4) Developing means for conformity assessment and MRA in voluntary sectors;

5) Encouragement of the implementation of good regulatory practices and business awareness and involvement;

6) SCSC stakeholders dialogue, including non-APEC cooperation, e.g., with the EU, WTO TBT and SPS Committees, and business involvement.

Resourcing and Supporting Standards and Conformance in the APEC Economies, the Pacific Area Standards Congress (2006)

This paper gives an opinion on the standards situation in the Asia-Pacific. APEC encourages greater alignment of member economies' standards with international standards. There are several sub-regional trade agreements that influence national standards. Examples include NAFTA, ANZCERTA, ASEAN, the Pacific Islands Forum, and the Northeast Asia Standards Cooperation.

According to the paper, the challenges to the greater adoption of international standards in the APEC region are the following:

- Global Relevance - In recent years, it has been documented that many international standards published by ISO and IEC are being used only in a limited number of economies;
- Standards Body Capacity – It is possible that a lack of capacity on the part of national standards bodies is a significant limiting factor inhibiting greater adoption of international standards by developing APEC economies. The adoption of international standards and participation in international standardisation are linked. Because of the sheer volume of international standardisation activities, no economy in the APEC region has the capacity to form a view on all of the developments in international standardisation. Both developed and developing APEC economies need to ensure that available resources are channelled into the most relevant activities for their economies and national standards bodies have a role to play in facilitating this process;
- Technological and Industrial Development - When the industries within an economy are still developing, perhaps using technologies that have been superseded in other places, it is sometimes not possible to implement the relevant international standards because they are written around the latest technologies. It is also difficult for an economy in this position to argue in committees developing international standards for recognition of less sophisticated technologies, when the economy itself acknowledges that it needs to progress towards world's best practice. In order to deal with this transitional situation, some sub-regional groupings, like the ASEAN Consultative Committee on Standards and Quality (ACCSQ) and the Pan American Standards Commission (COPANT), have promoted harmonisation of standards among their members. These standards take account of the specific economic and social situation in the sub-regions and serve a useful purpose along the road to economic development. However, it would be difficult to see such sub-regional standardisation activities being capable of embracing all developing economy needs across a region as diverse as APEC;
- Legal Conditions - APEC member economies have different levels of market failure. Where market failure is likely, government is often obliged to implement mandatory standards-based technical regulations and conformity assessment procedures to help prevent unsafe or unsuitable products from reaching the market, which is frequently seen as creating the greatest potential

for barriers to trade. APEC continues to work collaboratively with regulators to find common approaches and seek mutual recognition where appropriate.

The paper also provides a summary of legal metrology / metrology in the APEC region (APLMF and APMP) and a summary of accreditation in the APEC region (PAC-IAF and APLAC-ILAC).

APEC Regulatory Cooperation Process Mechanism on Trade-Related Standards and Technical Regulations, Committee on Trade and Investment (CTI) Report to Ministers, 2010

In 2010, CTI launched the 2010 APEC Initiative on Standards and Technical Barriers to Trade as a key element of its agenda to accelerate regional economic integration in the Asia-Pacific. Under this initiative, CTI agreed to establish a process in APEC that will encourage regulatory cooperation aimed at preventing and addressing unnecessary technical barriers to trade.

CTI envisaged that the APEC Regulatory Cooperation Advancement Mechanism (ARCAM) would consist of a process under which trade officials, relevant regulators, and other stakeholders would conduct work on one emerging regulatory issue per year that has particular relevance to APEC's agenda to strengthen regional economic integration.

APEC Guide to Support Quality Infrastructure Incorporation into MSMEs, 2017

In line with the importance of MSMEs in many member economies, particularly developing member economies, Peru led the development of this guide in 2017. The project included a survey of NSBs in member economies, and a workshop, in addition to a rigorous literature review. This report acts as a reference tool to assist economies in increasing awareness of standards and conformance among MSMEs, encouraging them to adopt and develop standards, and increase their involvement in standards development, conformity assessment and metrology agencies. Quality infrastructure is identified as a prerequisite for international trade participation, product compatibility and traceability, health and environmental protection, and supplier and consumer product confidence. As such, greater involvement by MSMEs promises to increase their access to new markets and GVCs.

The result was an important step towards the identification of best practices in relation to the incorporation of quality infrastructure into MSMEs in a sustainable way, with a view to helping them access regional and international markets and Global Value Chains. The report identified indicators and actions for barriers faced by SMEs. A few examples of those indicators are: number of MSMEs with the government mark on quality (or number of standards adopted by SMEs), number of MSMEs involved in SDOs, and standards outreach to SMEs. Case studies from member economies provide a snapshot of useful practices from around the region that have helped MSMEs develop capacity to deal with the standards system.

The case studies conducted for this guide highlight the best initiatives in each economy in promoting MSME competitiveness through greater involvement in standards and conformance. Japan's standards development program to create new market partnership framework to facilitate standardisation aims to target the lack of awareness of the importance of quality infrastructure through case studies by highlighting success stories and enhancing cooperation between NSBs and CABs. The initiative also improved the lack of financial and human resources by providing subsidies to MSMEs and hiring experts. Korea established a support

platform for the voluntary international standardisation of SMEs which tackles the same barriers identified by Japan. Chinese Taipei's initiative aims to improve sustainability by supporting MSMEs by continuously using standardisation, conformity assessment, and metrology and accreditation services. To tackle lack of financial resources, Chinese Taipei provides subsidies and tax reductions for investment in quality infrastructure.

4. METHODOLOGY AND APPROACH

In line with the project documents, we utilise a three-pronged approach for this assignment:

1. Establishment of a set of indicators.
2. Data collection.
3. Case studies.

In terms of methodology, we will combine qualitative and quantitative aspects. We now address the individual elements of the methodology separately, to provide an overview of the way in which we intend to move from a general presentation of S&C in APEC, as contained in the previous section, to producing detailed indicators at the economy level, and completing a case study.

INDICATORS AND DATA COLLECTION

An important prerequisite to data collection is a qualitative effort to outline the key elements of domestic standards and conformance infrastructure, and highlight the trade effects of S&C. Our starting point for the development of indicators is the quantitative information on participation in international and regional standards bodies in Tables 2 and 3. Wherever possible, we will use data on active participation, as well as membership. This information provides an overall, first brush assessment of economy-level approaches to quality infrastructure, and is in line with the importance of regional approaches to standards and conformance, and alignment on international standards, as promoted by APEC.

It is important to go beyond these basic indicators, however, to develop a more nuanced assessment of quality infrastructure within individual economies, and to relate it to global and regional development. The relevant data are not freely available, so we will rely on a questionnaire addressed to member economies in order to develop additional, more detailed indicators. The data collection exercise should be circumspect and targeted, so that it does not impose an undue burden on APEC economies. In light of the many bodies involved in standards and related activities within economies, we will be dependent on the good offices of SCSC delegates to assist us and PSU in identifying appropriate counterparts for administration of a short survey.

One issue the survey needs to confront is sectoral specificities. Economies specialise in the production of different goods, and as a result their standards structures are necessarily different. It is not appropriate to have the same approach for an economy where agriculture is a significant percentage of GDP, as for one where manufacturing plays a relatively larger role. With this in mind, we propose using the International Classification of Standards (ICS) to encourage economies to provide some amount of sectoral detail in relation to their standards and conformance practices. Mapping the ICS to goods sectors familiar to trade specialists is not straightforward, as the ICS adopts a more functional approach to classification of standards that often cuts across sectors. Nonetheless, we believe it is possible to develop a small number of aggregate sectors, to which specific questions can be mapped: general manufacturing (Fields 21-27; 39, 43, 45, 47, 49, 59, 61, 71, 77, 79, 81, 83, 85, 91); electronics and telecommunications (Fields 29-37); food and agriculture (Fields 65 and 67); services (Field 3); healthcare and

medical devices (Fields 7, 11 and 13); and extractive industries (Fields 73 and 75). The full list of ICS top-level fields is reproduced in Annex 3 to this Report, for reference.

The survey was administered by PSU, through SCSC. Table 3 summarises the information obtained and maps it to issue areas, and the Appendix reproduces the questionnaire for easy reference. The table maps questions to quantitative indicators and issue areas, to make clear that although the survey is brief and focused, it provides a wealth of information of relevance to APEC's work. Both Table 3 and the PSU questionnaire were extensively discussed by economies, and benefitted from inputs from a wide range of stakeholders.

In terms of presenting the results of the survey and desk work, we believe that the multi-faceted nature of modern quality infrastructure makes it desirable to present quantitative indicators following a dashboard strategy. The Conclusion sets out the indicators retained for the dashboard. Only a small sub-sample of the available data can be used, as the essence of a dashboard is that indicators should have an unambiguous directional interpretation, for example a higher score indicates superior performance. A key characteristic of APEC S&C systems that became apparent during this project is their diversity. As a result, only a small amount of basic information can be captured for the dashboard. The remainder of the data, discussed in detail in the next section, provides important indicators of institutional development and performance, but is not necessarily unambiguous in terms of its interpretation due to the wide diversity of systems in place.

Table 3: Mapping of Questionnaire Responses to Indicators and Issue Areas

Area	Issues	Proposed Indicators
Systems and Institutions	1. Which aspects of national quality infrastructure are currently established in your economy? (Metrology, accreditation, testing, certification, and standardisation.) 2. Which institutions are public, and which are private? How are they funded? What are the specific vision or mission of these institutions? 3. What is the approximate balance between public and private standards? Can a sectoral breakdown be provided? 4. How many laboratories or offices are available to provide standards and conformance related services? 5. How many new standards/accreditation programs have been developed in the past 3 years? 6. What services are being provided by the Conformity Assessment Bodies (CABs)? 7. Does your economy engage in standards outreach programs to	1. Binary indicators (1/0) for presence or absence of individual aspects of quality infrastructure. 2. Qualitative information on the interplay between public and private institutions, and their respective missions. 3. Numerical indicators showing the percentage of public and private standards overall and by macro-sector. 4. Quantity and quality of physical facilities. 5. Numerical indicators showing the number of standards/accreditation programs developed in the past 3 years. 6. Number of accredited testing laboratories. 7. Number of accredited certification bodies. 8. Services provided by CABs.

	communicate the importance of S&C?	9. Qualitative information on standards outreach efforts by S&C institutions.
Alignment with International S&C Systems	1. What is the approximate balance between mandatory and voluntary standards? Can a sectoral breakdown be provided? 2. What proportion of your economy's standards are harmonised with international standards (e.g., ISO or Codex)? Can a sectoral breakdown be provided? 3. The number of S&C institutions that have adopted the WTO TBT Agreement Code of Good Practice.	1. Numerical indicators showing the percentage of mandatory and voluntary standards overall and by macro-sector. 2. Numerical indicators showing the percentage of standards that are harmonised with international standards, overall and by macro-sector. 3. Numerical indicators showing the number of S&C institutions that have adopted the WTO TBT Agreement Code of Good Practice.[7]
Trade Facilitation	1. Does your economy have any mutual recognition agreements covering conformity assessment? If so, with which other economies?	1. Number of other economies with which a given economy has an MRA on conformity assessment.
Outcome	1. Does your economy maintain any data on business uptake of standards? If so, what are the most recent results? Can a sectoral breakdown be provided using the classification above?	1. Numerical indicators showing the percentage of business that use standards, overall and by macro-sector.

[7] Secondary data is available from ISO: https://tbtcode.iso.org/sites/wto-tbt/list-of-standardizing-bodies.html

5. ANALYSIS OF SURVEY DATA

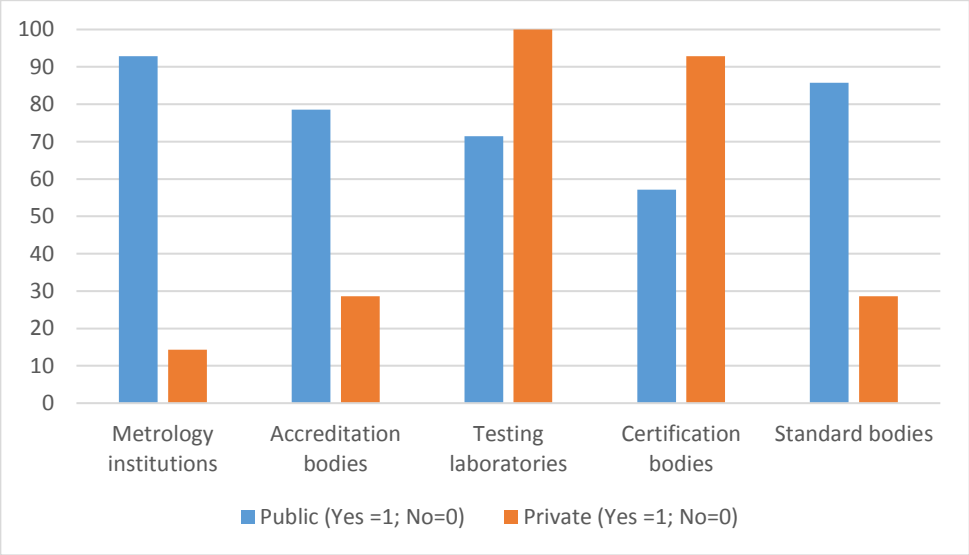
A key part of this project involves the acquisition of quantitative data on the state of quality infrastructure around the region. Section 2 surveyed the literature, and other publicly available sources of information. Much information of interest to member economies, however, is not in the public domain. PSU therefore administered a survey to the APEC economies, based on a draft questionnaire included in the Appendix. This section presents the summary results for the APEC region from that exercise; individual economy data are available upon request. Responses were received from 14 economies,[8] and the APEC figures are calculated based on simple averages across the economies.

There are some limitations in aggregating the survey results, such as different interpretations of the survey questions due to differences in understanding of the definitions, terms and processes; and in some economies certain data is not available.

ELEMENTS OF QUALITY INFRASTRUCTURE

The basic elements of quality infrastructure are well developed within APEC (Figure 3). All economies for which data are available have the five basic elements of quality infrastructure in place. As the figure makes clear, however, there are substantial differences in the involvement of the public and private sectors according to the type of institution, and the economy in question. In general, the public sector plays an important role in the institutions of quality infrastructure, although it is stronger in some economies than in others. Across all aspects of quality infrastructure, public and private sector actors coexist and cooperate, albeit in markedly different ways according to the economy in question; this is an aspect that is developed further in the case studies in Part 3 of this report.

Figure 3: Availability and Type of Quality Infrastructure in APEC (percent of responding economies)

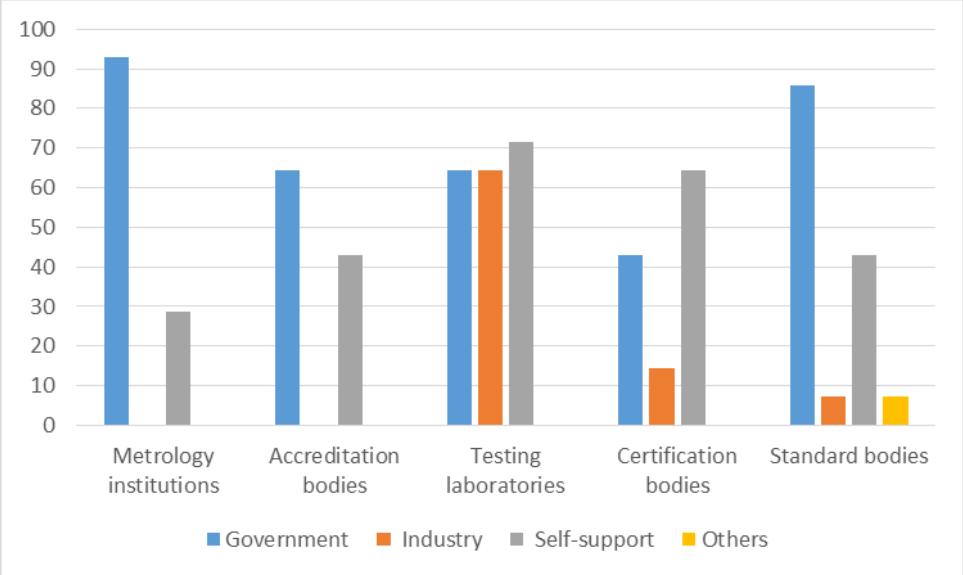


Source: PSU Survey; and authors' calculations.

[8] Australia, Canada, Chile, China, Japan, Malaysia, Mexico, Papua New Guinea, Peru, Philippines, Singapore, Chinese Taipei, Thailand, and Viet Nam.

In light of the mix of public and private institutions involved in quality infrastructure in APEC, it is not a surprise that there is also diversity in terms of funding sources (Figure 4). Government plays a strong role in funding most aspects of quality infrastructure across the region, but industry is also an important source of funds in some cases, particularly testing laboratories. Most elements of quality infrastructure also have a significant role for self-supporting funds, such as fees for services.

Figure 4: Funding Sources of Quality Infrastructure in APEC (percent of responding economies)



Source: PSU Survey; and authors' calculations.

ACTIVITIES OF KEY BODIES

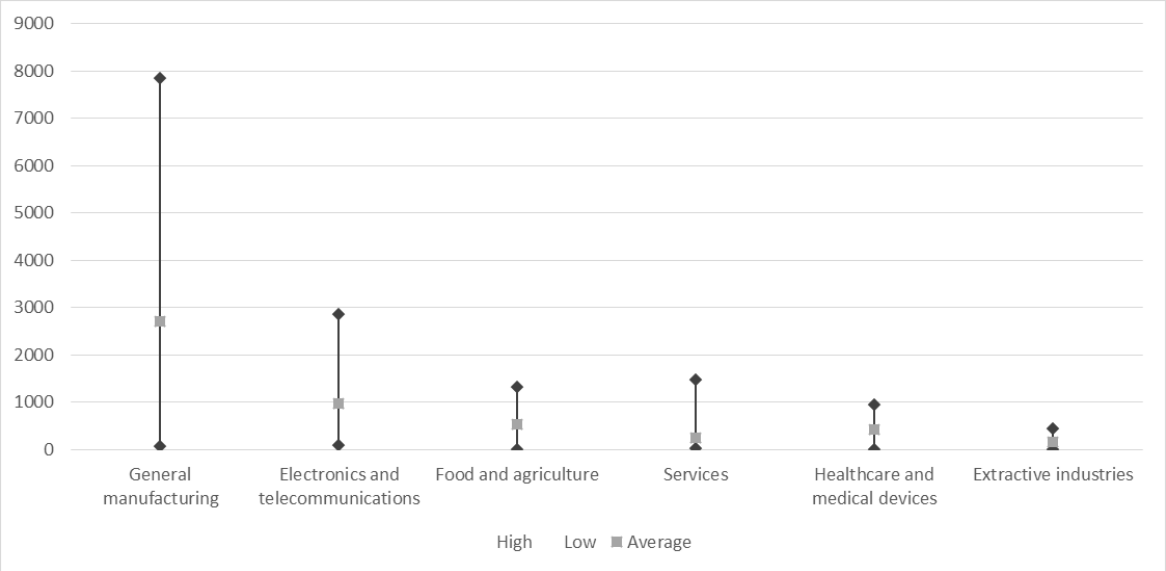
Survey data indicate that S&C bodies all around the region have been active in developing new norms and programs in recent years. On average, an APEC economy has developed 687 new standards programs in the last three years.[9] Although data on private standards are not available, there are indications of a robust approach to national standards, with an average of 5,845 standards per economy. However, the range is very wide, running from a minimum of 590 to a maximum of 13,891. Of these, around 18% are incorporated into technical regulations, which makes them legally mandatory. Certainly, the number of standards is only an indication of the level of activity, and does not directly map to quality, international alignment, or other issues of concern to policymakers. Nonetheless, this figure suggests that APEC economies generally have quite well-developed standards infrastructure.

Not all economies provided data on the degree of alignment of their standards with international standards. In a general sense, the degree of alignment is quite high with some variation across economies.[10] Some economies indicate that majority of their standards are aligned with international standards. In another indication that APEC economies are conscious of the international dimension of S&C, they report that on average around three S&C institutions per economy have adopted the WTO TBT Agreement Code of Good Practice.

[9] Data does not include Mexico.
[10] Economies answered the relevant survey question in different ways, sometimes giving numbers for individual components that cannot easily be aggregated.

Figure 5 shows that there are considerable differences in the intensity of standardisation activity across sectors, as would be expected. General manufacturing—admittedly a broad category—has the highest number of standards, followed by electronics and telecommunications. The remaining sectors—food and agriculture, services, healthcare and medical devices, and extractive industries—have relatively similar numbers of standards compared with the other two sectors. It is important to stress that although this picture may be complete for some economies, where essentially all standardisation activity takes place within the public sector, it does not take account of private standards, which are an important part of the quality landscape in some other economies. Another important factor to consider is the wide ranges we observe for the number of standards in each sector. For general manufacturing, for example, the APEC average number of standards is 2,714, but the range runs from just 72 to 7,841. Clearly, there are wide divergences in terms of the ways in which APEC economies go about designing and promulgating standards in key sectors.

Figure 5: National Standards by Sector (APEC average)[11]



Source: PSU Survey; and authors' calculations.
Note: Data unavailable for Australia, Chile, Mexico, and Papua New Guinea.

When it comes to conformity assessment and metrology in the S&C infrastructure, most APEC economies which participated in the PSU survey shared similar views on the effectiveness of joining mutual recognition agreements (MRAs)/multilateral recognition agreements (MLAs) with their economic partners and international institutions, citing that they help to facilitate international/regional trade and reduce technical barriers to trade, save time and cost by removing requirements for additional testing and certification in other signatory economies. This sentiment is in line with the fact that most APEC economies are signatories to the MRAs/MLAs with international institutions, as shown below in Table 4.

[11] Except for Mexico, Papua New Guinea, Chile and Australia.

Table 4: List of APEC Economies who are Signatories to Mutual Recognition Arrangements (MRAs) and Multilateral Recognition Arrangements (MLAs)

APEC Economies	Conformance							Metrology		
	APLAC [12]	IAF	ILAC	PAC	IAAC	ASEAN[13]	APEC EE MRA [14]	CIPM	OIML Basic [15]	OIML MAA [16]
Australia	√	√	√	√	X	X	√	√	√	√
Brunei Darussalam	X	X	X	X	X	√	√	X	X	X
Canada	√	√	√	X	√	X	X	√	X	√
Chile	X	√	√	X	√	X	√	√	X	X
China	√	√	√	√	X	X	√	√	√	√
Hong Kong, China	√	√	√	√	X	X	√	√	X	X
Indonesia	√	√	√	√	X	√	√	√	X	X
Japan	√	√	√	√	X	X	√	√	√	√
Republic of Korea	√	√	√	√	X	X	√	√	√	√
Malaysia	√	√	√	√	X	√	√	√	X	X
Mexico	√	√	√	√	√	X	X	√	X	X
New Zealand	√	√	√	√	X	X	√	√	√	√
Papua New Guinea	√	X	√	X	X	X	√	X	X	X
Peru	X	√	√	X	√	X	√	√	X	X
The Philippines	√	√	√	√	X	√	√	√	X	X
Russian Federation	√	X	√	X	X	X	√	√	√	√
Singapore	√	√	√	√	X	√	√	√	X	X
Chinese Taipei	√	√	√	√	X	X	√	√	X	X
Thailand	√	√	√	√	X	√	√	√	X	X
USA	√	√	√	√	√	X	X	√	√	√
Viet Nam	√	√	√	√	X	√	√	√	√	√
TOTAL	18 of 21 (86%)	18 of 21 (86%)	20 of 21 (95%)	15 of 21 (71%)	5 of 21	7 of 21	18 of 21 (86%)	19 of 21 (90%)	8 of 21 (38%)	9 of 21 (43%)

Source: Asia Pacific Laboratory Accreditation Cooperation (APLAC): https://www.aplac.org/aplac_mra.html; International Accreditation Forum (IAF): http://www.iaf.nu/articles/IAF_MEMBERS_SIGNATORIES/4; International Laboratory Accreditation Cooperation (ILAC): http://ilac.org/ilac-mra-and-signatories/; Pacific Accreditation Forum (PAC): http://www.apec-pac.org/content/pac-members (doc PAC-EXEC-009); Inter-American Accreditation Cooperation (IAAC): http://www.iaac.org.mx/English/MembersListMLASignatories.php; International Committee for Weights and Measures (CIPM): http://www.bipm.org/en/cipm-mra/participation/signatories.html; and International Organisation of Legal Metrology (IOLM): https://www.oiml.org/en/certificates/ [accessed: 17 August 2017]

As shown in the above table, in general, APEC economy is a signatory to existing MRAs/MLAs. This signifies that APEC economies are well aware of the benefits these MRAs/MLAs can bring to them. However, in the survey, some economies indicated that not

[12] Currently 39 of the 47 Full APLAC members are signatories to the APLAC MRA.
[13] ASEAN EE MRA and Pharmaceutical Good Manufacturing Practice (GMP) MRA.
[14] APEC also has the APEC TEL MRA in which all 21 APEC members have participated (plus ASEAN).
[15] Covers OIML basic certificates.
[16] Covers OIML Mutual Acceptance Arrangement (MAA) certificates, issuing and utilizing participants.

all users are well aware of how to take advantage of the facilities offered by these agreements. This highlights the challenge of increasing the uptake of S&C infrastructure services.

STAKEHOLDER INVOLVEMENT AND MOVING FORWARD

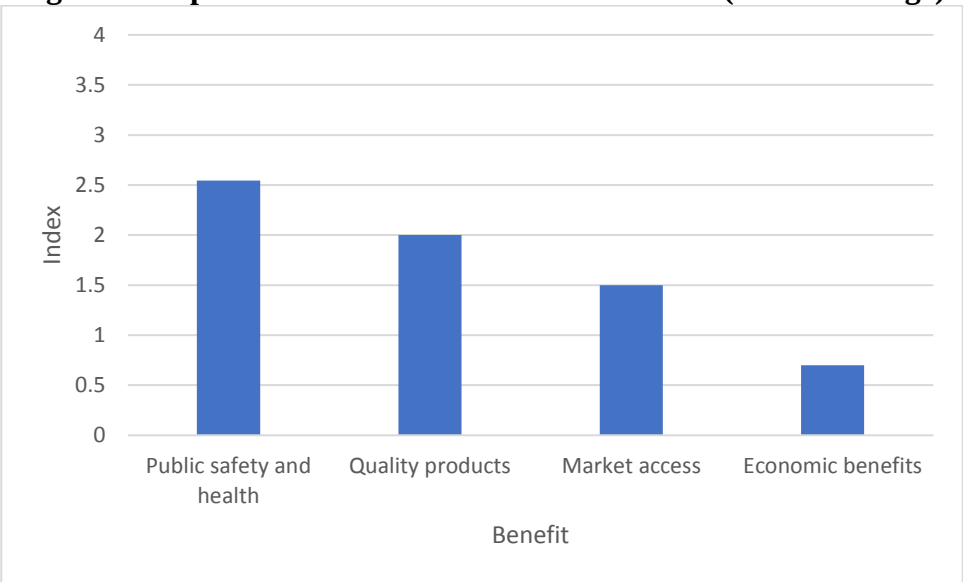
S&C bodies all around the region are aware that quality is not a static issue, but a dynamic one. Developing high-performing quality infrastructure, as well as supporting quality upgrading on the production side, requires a constant dialogue involving government, the private sector, and consumers. APEC S&C bodies recognise the importance of outreach: over 90% of economies for which data are available report that they engage in outreach programs to communicate the importance of S&C.

A key challenge for S&C bodies around the region is uptake of standards by the private sector. The issue is particularly acute in developing economies, where many businesses are MSMEs and may not be able to obtain financing to cover adaptation costs associated with compliance. As the case studies will show, some economies have adopted creative solutions to try and deal with this problem. However, the survey data indicate that only 23% of economies report maintaining data on consumer awareness and confidence in using certified products and accredited services. This figure does not directly map to business uptake, but it suggests there may be scope to give more of a demand-side impulsion to uptake by stimulating consumer demand for high-quality products. Although export markets can often play this role, the value of exports is mostly accounted for by large firms that can easily access resources to upgrade production. Domestic market dynamics are important for smaller firms, which are typically focused on local demand.

Given that technology and consumer preferences are rapidly changing, it is important that economies fully grasp the dynamic nature of S&C development through time. With this in mind, it is significant that 77% of economies reported having a process in place to develop national standards based on future needs.

Interestingly, APEC economies perceive the main benefits of S&C as lying in the areas of public safety and health, and quality upgrading on the production side (Figure 6). Although they are conscious of the economic benefits of S&C, including through improved market access, the need for appropriate regulation from a consumer protection standpoint remains critical in motivating the actions of APEC S&C bodies.

Figure 6: Importance of Perceived Benefits of S&C (APEC average)



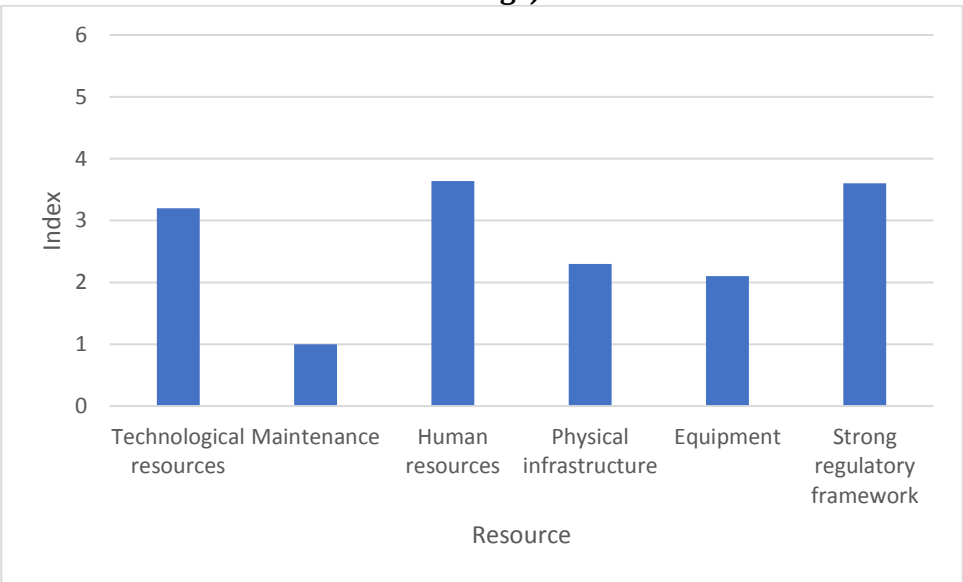
Source: PSU Survey; and authors' calculations.
Note: Importance index calculated as 4 minus the average rank (i.e., index = 3 if all respondents ranked the benefit as 1st; index = 0 if all respondents ranked the benefit as 4th).

The final issue addressed by the survey looks at the way forward for S&C in APEC economies. Specifically, economies were asked to identify the key resources required for maintaining and enhancing S&C infrastructure. Three factors stand out as being particularly important for continued S&C development: technological resources, human resources, and a strong regulatory framework. Interestingly, they are ranked on average as more important than investments in physical infrastructure and equipment. Experiences certainly differ significantly across economies, related in particular to their level of development, however, this result suggests that the key interventions needed to keep APEC's S&C infrastructure on track to continue responding to the needs of the marketplace lie in "soft" areas, like regulatory reform, and education and training.

Regulatory reform is an area where sharing experiences among economies can potentially be very beneficial, in particular by facilitating information exchange among developing economies, which could potentially adopt useful steps implemented elsewhere. Development of human resources, on the other hand, is primarily a domestic issue, related to generalised shortages of skilled professionals in some developing economies. Many S&C functions require a considerable degree of education and training, relating for instance to scientific methods, and the use of specialised instruments. Investing in high-quality testing facilities, for example, will not bear its full fruits unless highly qualified staff are available to conduct tests in accordance with prevailing norms.

International cooperation can be useful in terms of building up human capacity, and indeed the case studies provide examples of APEC economies engaging with institutions in the region to boost the performance of staff and facilities domestically. As in many other areas, though, quality infrastructure requires substantial investments in higher education going forward—an issue that finds resonance across other areas within APEC.

Figure 7: Importance of Resources for S&C Maintenance and Enhancement (APEC average)



Source: PSU Survey; and authors' calculations.
Note: Importance index calculated as 6 minus the average rank (i.e., index = 5 if all respondents ranked the resource as 1st; index = 0 if all respondents ranked the benefit as 6th).

6. CASE STUDIES

This section presents the case studies[17] on six APEC economies, covering both developing and developed economies and spanning across the Asia-Pacific. The purposes of the case studies are to flesh out the insights gained from survey responses, and provide additional details on how the S&C systems operate in practice. The authors are grateful to the economies under study for making the arrangements and facilitating the meetings with various organisations as well as for devoting resources to provide the information and data.

AUSTRALIA

Standards and Conformance[18] Policy[19]

Australia is a signatory to the WTO Technical Barriers to Trade (TBT) Agreement, and is committed to ensuring that mandatory standards and conformity assessment procedures are not more trade restrictive than necessary. As part of this, Australia actively participates in international standard-setting organisations and prefers the adoption of the resulting international standards. In Australia, the Commonwealth Department of Industry, Innovation and Science (DIIS) is the Australian Government's lead organisation for standards and conformance (S&C) policy issues. In this context there are four key organisations that make up Australia's S&C infrastructure, namely: National Measurement Institute, Australia (NMIA), Standards Australia, National Association of Testing Authorities, Australia (NATA), and Joint Accreditation System of Australia and New Zealand (JAS-ANZ). Together, these four organisations cooperate as the Australian Technical Infrastructure Alliance (ATIA)[20], whose purpose is to identify and execute joint projects to enhance the national S&C infrastructure.

DIIS participates on the governance bodies of the three bodies external to the Department: in the Standards Development and Accreditation Committee of Standards Australia, as an observer on the Board of NATA, and on the Governing Board of JAS-ANZ. DIIS manages the relationship with these three agencies through collaborative stakeholder engagement.

DIIS seeks to facilitate international trade and improve market access for Australian industry by breaking down technical and regulatory barriers to trade. It also plays a significant role in promoting the adoption of international standards and the mutual recognition of conformity assessment results.

In order to do so, DIIS participates in meetings of the APEC Sub-Committee on Standards and Conformance (SCSC), supports the Department of Foreign Affairs and Trade (DFAT) during the negotiation of TBT chapters in FTAs, is responsible for the implementation of TBT Chapters in FTAs, and oversees and manages various Mutual Recognition

[17] The case studies were drafted around June - August 2017.
[18] The term "standards and conformance infrastructure" is synonymous with "quality infrastructure" and "technical infrastructure" (e.g. The National Quality Infrastructure - World Bank and OECD's Innovation Policy Platform).
[19] Department of Industry, Innovation and Science, Australia's Standards and Conformance Infrastructure – An Essential Foundation, July 2016, at: http://www.industry.gov.au/industry/IndustryInitiatives/TradePolicies/TechnicalBarrierstoTrade/Documents/StandardsandConformanceReport.pdf
[20] http://www.atia.org.au/

Arrangements/Agreements (MRAs), including with the European Community, European Free Trade Association, Singapore and New Zealand.

Standards and Conformance (S&C) Infrastructure Agencies

National Measurement Institute, Australia (NMIA)

NMIA was formed in 2004 as a result of merging the three existing national bodies responsible for chemical and biological, physical, and legal metrology (measurement science), thereby making it one of the few institutes globally that cover the spectrum of scientific and legal metrology functions. In 2010, the responsibility for trade measurement, previously delegated to Australia's states and territories, also came under NMIA's administration.

NMIA is responsible for Australia's peak physical, chemical and biological measurement standards, as well as its legal metrology framework. NMIA disseminates these peak measurement capabilities to stakeholders including government, industry and other research and S&T agencies through a range of services (e.g. calibrations, reference materials, training and consultancies). In recent years, NMIA has established a "sector strategy", to bring a multi-disciplinary approach to addressing measurement challenges in priority sectors for the Australian economy, e.g. health, environment, energy and food safety.

NMIA has an enforcement role through its legal metrology function, specifically in the area of trade measurement. NMIA maintains and implements a risk-based compliance and enforcement strategy, focusing on sectors with high levels of non-compliance and/or where non-compliant practices would result in significant economic harm. Compliance and enforcement actions are undertaken by Trade Measurement Inspectors, who also provide education and training to individuals and businesses that use and rely upon accurate measurement in trade.

NMIA is an essential element of Australia's S&C infrastructure and works collaboratively with the other S&C organisations, providing measurement advice as well as actively participating as technical experts for NATA assessments and on technical committees for NATA and Standards Australia. On behalf of Standards Australia, NMIA experts also participate as members of Australia's delegations to ISO and IEC.

Standards Australia

Standards Australia was established in 1922 and is the peak standards organisation in Australia. It is charged by the Australian Government to meet Australia's need for contemporary, internationally aligned standards and related services. Standards Australia is responsible for the facilitation and development of voluntary standards in Australia. They are, however, not responsible for certification and market surveillance nor do they have a role in testing against standards.

Standards Australia plays a facilitation role in reaching out to stakeholders from across government and industry. This is carried out by their stakeholder engagement team with individuals assigned to look after various sectors. Using the ICT sector as an example, the stakeholder engagement manager will consult and liaise with DIIS, the Department of Communications and the Arts, and the Department of the Treasury. Standards Australia will also have extensive contacts with industry associations, universities and technical specialists.

This approach gives Standards Australia the assurance that they are producing documents (standards and lower consensus documents) that will have wide stakeholder support.

Conformity assessment activities are left to the other S&C organisations such as NATA and JAS-ANZ, which Standards Australia works closely with. There is good partnership among the S&C partners; they sit in each other's committees and the CEOs meet on a quarterly basis.

National Association of Testing Authorities, Australia (NATA)

Established in 1947, NATA is recognised by the Australian Government as the peak body for the accreditation of laboratories, producers of reference materials and proficiency testing scheme providers throughout Australia. NATA also offers accreditation for inspection bodies and is Australia's compliance monitoring authority for the OECD Principles of Good Laboratory Practice.

NATA accreditation ensures that member facilities comply with relevant international and Australian standards. This verifies that they are competent to provide consistently reliable testing, calibration, measurement and inspection data to government, industry and the wider community. NATA engages technical assessors drawn from the industry and professional bodies, and will match the particular fit of an expert and a particular conformity assessment body they are assessing.

Where relevant there is close collaboration between NATA and the other S&C organisations. For example, technical experts from NMIA participate in NATA as technical assessors. Standards developed by Standards Australia form the basis of the scopes of accreditation of many NATA-accredited facilities. NATA also participates in technical committees as part of Standards Australia's standards development processes.

Proficiency Testing Australia (PTA) used to be part of NATA until 2006 with the introduction of ISO/IEC 17011 which specifies that accreditation bodies should not conduct proficiency testing for their laboratories. While the PTA is now a wholly owned subsidiary of NATA, they have no say in each other's operations, and have separate Boards and staff. PTA offers testing programs covering chemical, biological, mechanical, construction and non-destructive materials, as well as provides training and statistical consultancy. While both NMIA and PTA offer proficiency testing, they do not duplicate what the other is doing.

Joint Accreditation System of Australia and New Zealand (JAS-ANZ)

JAS-ANZ was established in 1991 through the signing of an agreement (treaty) between the Australian and New Zealand governments. The treaty was established to promote trade between Australia and New Zealand, and with other economies. Legal status was conferred by regulation in both economies. JAS-ANZ is accountable to both governments through DIIS (Australia) and the Ministry of Business, Innovation and Employment (New Zealand).

The JAS-ANZ Treaty established the Governing Board, Technical Advisory Council and Accreditation Review Board. The Treaty requires JAS-ANZ to operate a joint accreditation system and to deliver on four goals:

Goal	Statement

Integrity and Confidence	Maintain a joint accreditation system that gives users confidence that goods and services certified or inspected by accredited bodies meet established standards.
Trade Support	Obtain and maintain acceptance by Australia's and New Zealand's trading partners for domestic management systems and exported goods and services.
Linkages	Create links to relevant bodies that establish or recognise standards for goods and services or that provide conformity assessment.
International Acceptance	Obtain mutual recognition and acceptance of conformity assessment with relevant bodies in other economies.

In following these goals, JAS-ANZ can ensure that its accreditation enhances national, trans-Tasman and international trade to achieve international recognition for the excellence of Australian and New Zealand goods and services.

JAS-ANZ accredits the bodies that certify or inspect organisations, products or people. They develop the assessment criteria certifiers and inspectors must meet to become accredited under these themes: 1) business and innovation; 2) health and human services; 3) product certification; 4) food and biological systems; and 5) environment. Once accredited, the accredited body will be able to use the JAS-ANZ symbol, which is a sign of assurance that the goods and services certified by accredited bodies meet established standards.

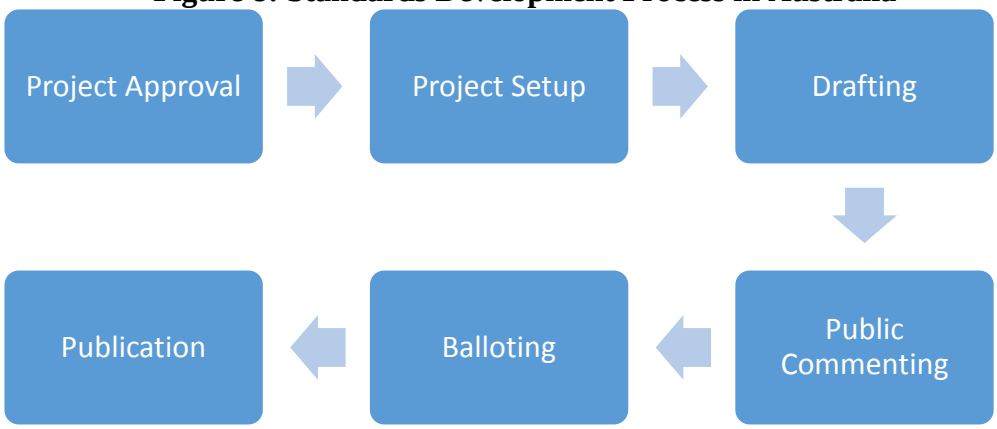
JAS-ANZ establishes linkages with a whole range of stakeholders, including the Australian and New Zealand Governments, scheme owners, international accreditation organisations, standards and conformance technical bodies, and industry.

JAS-ANZ works closely with other S&C organisations, notably NATA and NMIA. JAS-ANZ also participates in technical committees as part of the standards development processes of Standards Australia and Standards New Zealand.

Standards Setting in Australia

The following figure depicts the standards development process in Australia.

Figure 8: Standards Development Process in Australia



Source: Standards Australia, Developing Australian Standards

Standards Australia has a project proposal submission and assessment system[21]. Anyone requesting to develop a new standard or to revise or amend an existing standard will need to submit a proposal form and demonstrate that it provides a net benefit to the Australian community. In demonstrating a net benefit, the proposal will include information detailing the scope of the project, what benefit it aims to bring to Australia, and whether stakeholders support the proposal. A significant aspect of the proposal is to identify whether there is an equivalent international standard to fulfil Australia's obligations under the WTO TBT Agreement and is in accordance with the Australian Government's policy to adopt international standards wherever possible. If there is one available and yet the stakeholder wants to develop a unique Australian standard, the onus is on the stakeholder to justify why they need a different Australian standard. In analysing the net benefit, consideration is given to: public health and safety; social and community impact; environmental impact; competition; and economic impact.

All proposals received will be listed on Standards Australia's website for public review. This is to ensure the transparency of the proposed projects and to facilitate stakeholder interaction in advance of project approval. It then decides whether the proposals would go ahead based on the project prioritisation and selection process[22]. In the last 12 months, Standards Australia has developed or revised 348 documents, and half of those are identical text adoption from ISO and IEC. The rigour of Australia's standards development process has attracted other economies like South Africa (SABS) to adopt a similar process.

Standards Australia maintains an internal register containing the public comments received on draft standards and the technical committees' responses to those comments. Generally, there is one round of public comment (normally not less than 9 weeks), although there are situations where the draft standards will need to go through multiple rounds of public comment. This additional consultation will usually occur in contentious areas, with one such example concerning the development of standards for the sterilisation of medical devices. As part of maintaining a high level of consultation, Standards Australia will organise regular meetings, forums and workshops between the technical committees and key stakeholders to provide them with opportunities to increase dialogue and awareness of key issues.

Using Standards in Policy and Regulation

Australian standards are voluntary unless they are referenced in laws or regulations thus making them mandatory. Standards can be referenced at the federal, state/territory and local government level (note: three levels of government in Australia). The standards mostly referenced in laws and regulations fall under the areas of building, energy, health, environment, and safety. Currently, about one-third out of the 7,000 Australian Standards are referenced in federal, state/territory or local government regulations.

Over recent years, the Australian Government has been progressing a deregulation agenda to help streamline regulation and set an environment for businesses where they can thrive and

[21] Standards Australia, Standardisation Guide 001: Preparing Standards, at http://www.standards.org.au/StandardsDevelopment/Developing_Standards/Documents/SG-001%20Preparing%20Standards.pdf

[22] Standards Australia, Standards Australia Guide - Project Prioritisation Process and Criteria, at http://www.standards.org.au/StandardsDevelopment/Developing_Standards/Documents/GU104%20-%20SA%20Guide%20to%20Project%20Prioritisation%20Criteria%20and%20Process.pdf

innovate. To help reinforce this, the Australian Government adopted the principle that "*if a system, service or product has been approved under a trusted International Standard or risk assessment, Australian regulators should not impose any additional requirements unless it can be demonstrated that there is a good reason to do so"*[23]. Ensuring that international standards are used where possible can help lower barriers to trade, and assist businesses in becoming more competitive.

In addition, before considering the use of standards in support of policies, policy officers are required to think about the regulatory options and implications through a Regulatory Impact Assessment (RIA) process. In general, before proposing the use of any standard, they should ensure that non-regulatory approaches are considered and that regulation is not the default option. When it comes to considering the standard to be used, the following criteria should be used to determine if the standard can be applied or adopted to an Australian setting, namely: feasibility and appropriateness; accepted best practice; harmonisation; influence; and international obligations[24]. These requirements are set out in the Australian Government's "Best Practice Guide to Using Standards and Risk Assessments in Policy and Regulation[25]."

Though not compulsory, voluntary standards are used widely by industry, including standards such as ISO 9001 on quality management, ISO 22000 series on food safety (applies to food coming into Australia), which may be called into contracts although they are voluntary. A good example of the importance of using relevant international standards is around ISO/IEC standards on service level agreement for cloud computing. As a cloud service provider, companies will need to be familiar with relevant international standards in order to be best placed to offer cloud computing services offshore. As such the use of international standards is imperative to facilitate cross-border trade.

Resources Available

NMIA receives government funding to undertake its core roles and responsibilities. In addition, it obtains revenue from service delivery, which is provided on a cost-recovery and competitive neutrality basis. Most of NMIA's external revenue comes from its chemical analysis and testing services. NMIA also undertakes proficiency testing, complementary to (rather than duplicating) the areas covered by Proficiency Testing Australia (PTA).

DIIS maintains the Australian government's MoUs with Standards Australia and NATA, and also provides funding to both organisations for certain international activities through the Support for Industry Service Organisations (SISO) program.

Standards Australia funds their own activities, although they also receive funding (AUD 2.5 million per year) from DIIS through the SISO program, whereby most of these funds go towards subsidising Australia's participation in ISO and IEC technical committees. Standards Australia also receives funding support from DFAT, the Treasury and other external

[23] https://www.pmc.gov.au/sites/default/files/publications/industry_innovation_competitiveness_agenda.pdf;
[24] Department of Industry, Innovation and Science, Best Practice Guide to Using Standards and Risk Assessments in Policy and Regulation, July 2016, at https://www.industry.gov.au/industry/IndustryInitiatives/PortfolioRegulationReform/Documents/Best-practice-guide-to-using-standards-and-risk-assessments-in-policy-and-regulation.pdf
[25] https://www.industry.gov.au/industry/IndustryInitiatives/PortfolioRegulationReform/Documents/Best-practice-guide-to-using-standards-and-risk-assessments-in-policy-and-regulation.pdf

organisations for specific activities. In addition, Standards Australia receives some funding from the sale of Australian Standards.

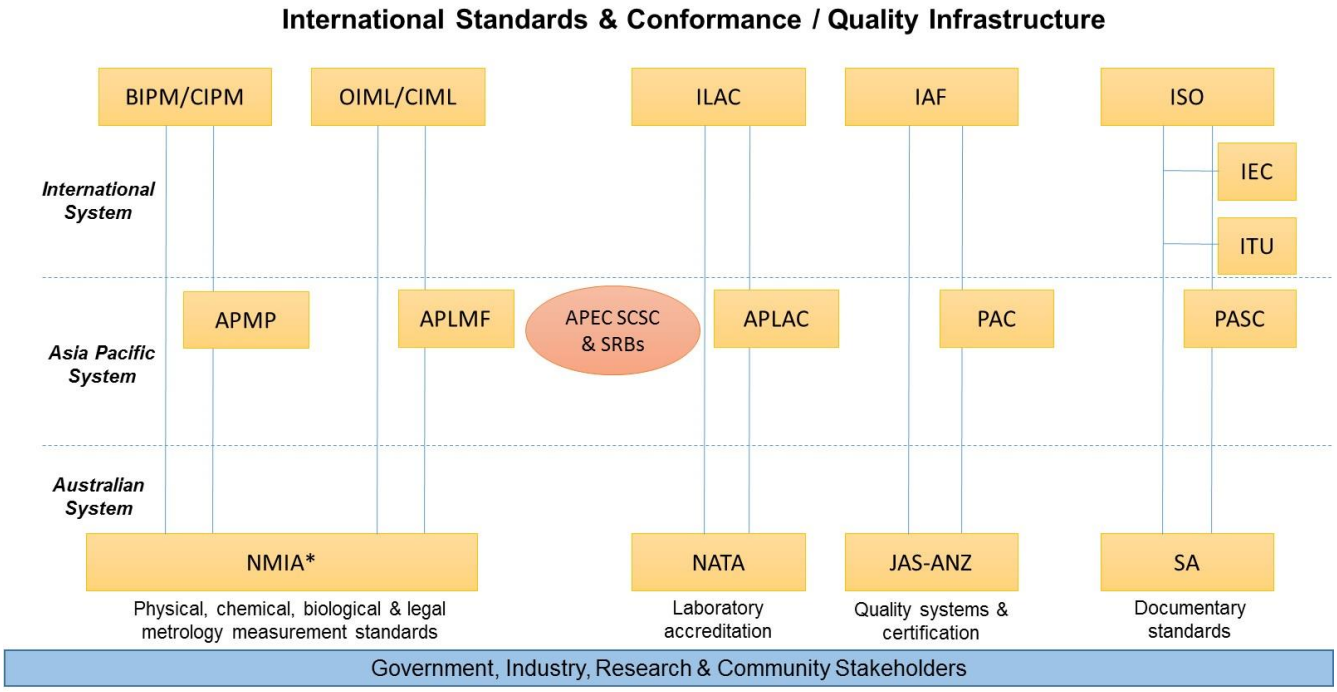
NATA's operations are funded mostly through accreditation fees. NATA also receives about AUD 1.4 million a year from DIIS (through the SISO program) to allow national representation in ISO, ILAC, APLAC, OECD GLP and other agreed activities. NATA is also supported by some 3,000 volunteer technical experts who mostly provide their services for free. These experts assist NATA in their various technical committees and as technical assessors.

JAS-ANZ is a not-for-profit organisation and is funded by the commercial activities it provides. It has been operating on a sustainable financial model based on three key objectives: (1) Ensure sufficient reserves to meet future liabilities or shocks; (2) Australian and New Zealand Governments are insulated from any claims arising from operations; and (3) There is continued investment in capacity-building.

Alignment with International Standards, International Engagement and Involvement with MRAs

The figure below depicts the S&C infrastructure at three levels – international, Asia Pacific, and Australia.

Figure 9: S&C Infrastructure in Australia



Source: NMIA presentation slides "The National Measurement Institute, Australia (NMIA): An Overview", 13 July 2017

Standards Australia. Standards Australia looks to adopt international standards to the maximum extent possible, also reflecting the Government's principle of first adopting international standards where possible, to facilitate trade.

In the case of direct text (or identical) adoption of international standards, Standards Australia runs the process in a streamlined manner, such that the project proposal can be submitted at any time of the year. In the case of revision or modification of international standards or new standards, the proposal will need to go through the project prioritisation process which happens twice a year. In 2016-17, of the 214 standards published, 55 per cent were identical or modified international adoptions. Approximately 37 per cent of Standards Australia's total catalogue of Australian Standards are international adoptions.

By sector, the highest international alignment of standards can be found in the areas of energy and electrotechnology, but this is changing. There are two areas of growth in Australia: ICT, and management systems and service standards (these kinds of standards are growing in Australia and internationally - energy management, compliance management, and audit management).

In order to maintain a contemporary catalogue of Australian Standards, Standards Australia reviews the standards regularly and runs a process called the "Aged Standards Review"[26]. Australian Standards that have been published for more than 10 years in their current edition are subject to a review process. If the aged standard is not managed by any active technical committee, Standards Australia will seek the views of the general public. If it is managed by an active technical committee, the responsible project manager will request the technical committee to reconfirm, revise or remove the standard. They will also see if there is any international standard that can replace it, which is often the case.

Standards Australia represents Australia in ISO and IEC. Regionally, they participate in the Pacific Area Standards Congress (PASC), and also work with the government in the S&C activities of SCSC and the implementation of TBT Chapters in free trade agreements. Standards Australia also has MoUs and technical standards agreements with other National Standards Bodies (NSBs). For example, Standards Australia has an MoU on standards cooperation with Singapore under the Singapore-Australia Comprehensive Strategic Partnership; an agreement with New Zealand (over 70 per cent of New Zealand standards catalogue is based on joint Australia-New Zealand standards); and MoUs with Papua New Guinea and Fiji.

Standards Australia is currently working with its Indonesian counterpart on a standards trade related mapping project to inform the Australia-Indonesia Comprehensive Partnership Agreement which is under negotiation. More SMEs in Indonesia are doing business in Australia and vice versa, hence the purpose of the mapping project is to find out areas of convergence and opportunities to support possible future standards harmonisation, technical alignment and regulatory coherence. Other work Standards Australia has been progressing internationally is assisting Fiji to upgrade its National Building Code, and leading an APEC SCSC project on behalf of Australia that aims to look at the role standards play in innovation and driving APEC's Silver Economy.

NMIA. Internationally, NMIA represents Australia in activities under the two global inter-governmental treaties in metrology – the Metre Treaty for scientific measurement, and the OIML Convention for legal metrology. The peak bodies under these treaties are the International Committee for Weights and Measures (CIPM) and the International Organisation

[26] See Aged Standards Review at:
http://www.standards.org.au/StandardsDevelopment/Developing_Standards/Pages/Withdrawing-Standards.aspx

of Legal Metrology (OIML). As such, NMIA is Australia's official signatory to the CIPM Mutual Recognition Arrangement (CIPM MRA) and the OIML Mutual Acceptance Arrangement (OIML MAA – to be replaced from January 2018 by the OIML Certification System, OIML-CS).

In the Asia Pacific, NMIA is Australia's official representative to the Asia-Pacific Metrology Programme (APMP) and the Asia Pacific Legal Metrology Forum (APLMF), two of the five Specialist Regional Bodies (SRBs) identified by APEC to support, in particular, the work programmes of the APEC SCSC. Through its membership of APMP, NMIA has also been actively involved in APEC's Food Safety Cooperation Forum (FSCN) Partnership Training Institute Network.

NMIA has formalised bilateral collaborations with international partners including: China; Japan; Germany; USA; New Zealand; UK; the Netherlands; and the Gulf region. NMIA also contributes expertise and leadership within the Asia Pacific, including supporting capacity building activities to develop regional scientific and legal metrology capabilities through externally funded projects (e.g. the German government-funded 'Metrology: Enabling Developing Economies in Asia' [MEDEA] programme).

NATA. NATA represents Australia in the International Laboratory Accreditation Cooperation (ILAC); the Asia Pacific Laboratory Accreditation Cooperation (APLAC); and the OECD Working Group on Good Laboratory Practice. Their competence as an accreditation provider is regularly evaluated by ILAC and APLAC for continued inclusion in MRAs, thus ensuring that NATA's operations remain consistent with international practices. NATA similarly provides evaluators to ILAC and APLAC who lead or participate in MRA evaluations of its mutual recognition partners. NATA also represents Australia in relevant ISO committees and technical committees of other international bodies such as IEC and CODEX Alimentarius.

In the early days of accreditation NATA provided extensive training to economies in the region. Contact with regional MRA partners now takes the form of expert liaison on topics of mutual interest. This allows detailed discussion on standards and national requirements.

While NATA's focus is on domestic stakeholders, NATA may consider servicing the needs of Australian companies in other economies exporting to Australia. Some companies who operate in a few economies also prefer to use only one accreditation body.

JAS-ANZ. JAS-ANZ has established arrangements with the International Accreditation Forum (IAF), the International Laboratory Accreditation Cooperation (ILAC), the Pacific Accreditation Cooperation (PAC), and the Asia Pacific Laboratory Accreditation Cooperation (APLAC). These provide a basic level of cooperation within a regional and global network of similar bodies. A series of MoUs have also been established for bilateral cooperation with specific bodies. These provide for a greater level of cooperation and support activities such as training, staff placement, joint assessments and information sharing.

Benefits for Business and Trade

S&C are important to facilitating international trade. Australia places a high importance on this, and is why Australia actively participates in a range of international fora.

Standards

The promotion and use of international standards is an important trade facilitation mechanism, and can assist small and medium sized enterprises to take part in global value chains and benefit from technology transfer. International standards also stimulate trade, and help overcome artificial trade barriers. This makes it easier for firms to get their products certified and allows them to become more competitive in the global market place. In a highly globalised sector like ICT, conforming to international standards will make it easier to connect with other firms. For example, the ISO 27000 series deal with security techniques. A firm not using these standards may find it hard to provide cybersecurity services to the government and industry in other economies. Similarly, if international standards are not used in cross-border data and information flows, firms may face constraints when participating in global value chains.

The harmonisation of international standards can have benefits to all industries, and this is a key objective of the APEC SCSC. Under the Food Safety Cooperation Forum (FSCF), a sub-group of SCSC, it has been recognised that pesticide use varies between APEC economies resulting in trade barriers. The FSCF has been leading work to harmonise economy's import maximum residue limits (MRLs) in line with international MRL standards in order to facilitate trade. Food Standards Australia New Zealand are one of the Co-Chairs of the FSCF and have been leading this work to produce a guideline document to support the harmonisation of pesticide MRLs across APEC economies with international standards.[27]

Figure 10: Value Chain for Accreditation

Source: JAS-ANZ Statement of Corporate Intent 2016/2019

[27] APEC, Import MRL Guideline for Pesticides, at http://publications.apec.org/publication-detail.php?pub_id=1750

Accreditation

Accreditation, like what NATA and JAS-ANZ provide, benefits the entire value chain; from the conformity assessment bodies, their clients, and the end-consumers to the market. The benefits include reducing compliance and transaction costs, reducing risk, streamlining operations, breaking down barriers to trade therefore providing greater access to foreign markets, and giving assurance that the goods and services sold are safe and can be used for their intended purpose. Figure 10 demonstrates the value chain for accreditation.

What it shows is that conformity assessment, that is, the certification or inspection of products and services, plays an important role in the large and complicated market for goods and services.

Primarily, it allows organisations who meet specified standards to signal the quality and reliability of their goods and services to their customers. An overt symbol or mark of quality and reliability is a valuable asset in itself and in response to demand for this, over time, many conformity and assessment bodies (CABs) have emerged to provide certification and inspection services.

For certification to be meaningful, it must consistently and reliably signal quality and, therefore, should only be awarded to products and services that meet specified standards. However, in a market where hundreds of CABs are in operation, it is difficult for CABs themselves to provide verification of the value of their certification product. JAS-ANZ and NATA, as not-for-profit accreditation bodies, play the important role of accrediting CABs to assure that their services are provided with competence and independence.

Ultimately, the service that JAS-ANZ and NATA provide indirectly changes both the nature and the size of the markets in which the accredited good and services are part of. This can happen in several ways. For example, by underpinning consumer confidence and reducing information asymmetries, consumers are more discerning and able to demand and purchase higher quality goods and services, this in turn influences producers and the supply of quality goods and services – hence the nature of the market is changed.

By promoting trade and expanding into new markets, for both CABs and their clients, the market is expanded and hence economic growth is generated. By lowering one or more of the costs of the inputs into production – such as the costs of accessing required information – then production will tend to be higher, and economic growth is further stimulated.

Metrology

Measurement expertise and services provided by NMIA can help to improve manufacturing capabilities and products and enable innovation. In one case study, NMIA assisted a leading Australian SME and manufacturer of LED optical technologies secure a multi-million dollar international tender. NMIA was able to develop testing capabilities to demonstrate compliance of the company's products with international photobiological safety standards, a requirement in the tender to supply forensic light sources to the South African Police. The company is now

developing a new product range and plans to involve NMIA in the pre-commercialisation development and testing phase.[28]

Through mutual recognition and acceptance of measurement capability across borders (i.e. effective participation in the CIPM MRA and OIML-MAA/-CS), NMIA supports the removal of unnecessary duplication of testing, hence keeping manufacturing costs low, simplifying regulation and allowing firms to remain competitive. For example, the U.S. Federal Aviation Administration requires all relevant measurements for the maintenance and repair of aircraft to be traceable to the US NMI, the National Institute of Standards and Technology (NIST). Due to its participation in the CIPM MRA, NMIA was able to demonstrate the equivalence of relevant Australian and U.S. measurement standards, resulting in substantial savings for the industry in terms of time and costs.

What's Facing S&C Infrastructure

Government. In terms of standards development the Australian Government has taken the view that community and industry consensus should drive standards that are fit for purpose to meet the economy's needs, rather than government dictating the direction of standards development. While the basic principle remains the same, the Government works with the S&C infrastructure to help identify linkages between Government priorities and the standards development process. An example is the new international standards on Blockchain, which Australia proposed to the ISO and was approved[29]. Australia is now the secretariat to the new technical committee, ISO TC 307 Blockchain and distributed ledger technologies. This development came about as a result of the Government's and industry's strong interest in fintech. With some additional Government investment, Standards Australia was able to take a first mover advantage by putting forth a New Field of Technical Activity proposal to ISO to develop international standards on Blockchain.

To respond to current trends, the Australian Government has also invested in Industry Growth Centres, which mirror national priorities[30]. Industry Growth Centres are industry led, and focused on areas such as advanced manufacturing, pharmaceuticals, medical technologies and pharmaceuticals, and cyber security. Through these Industry Growth Centres, Australia is increasingly involved in exploring how standardisation can assist these sectors – for example, how standards can facilitate the Fourth Industrial Revolution (Industry 4.0). In this particular instance, the Government matches public sector priorities with the industry-led standards development process.

The Australian Government also maintains a Commonwealth, Standards and Conformance Advisory Group (CSCAG), which meets two to four times a year. This provides a forum for federal government agencies to connect with the executive of the S&C infrastructure bodies to discuss the latest trends and emerging issues related to standards and conformance and policy development.

Standards Australia. From the standards developer's point of view, Standards Australia monitors developments in the standards ecosystem that may be of national interest and align

[28] NMIA presentation slides "The importance of measurement as a key component of an effective quality infrastructure to support MSMEs", 2016
[29] Standards Australia, Blockchain Standards Initiative, at: http://www.standards.org.au/OurOrganisation/News/Documents/Blockchain%20Standards%20Initiative.pdf
[30] https://industry.gov.au/industry/Industry-Growth-Centres/Pages/default.aspx

with the Australian Government's national strategic priorities. It considers what type of opportunities and investment would be needed to bolster standards development for initiatives to the benefit of the economy, and connects with Government with relevant proposals, for example to support the coordinated development of standards associated with smart cities or cyber security. Standards Australia will then undertake research in such areas. In a way, Standards Australia's approach is reactive and opportunistic; they look at what the Government and industry are interested in. Hence, their work is mostly demand (stakeholder) driven since it will depend on the needs of the stakeholders. The onus then falls on the industry, government, consumers and other affected stakeholders to advise the standards they need and to see if standards can provide a solution.

There are challenges facing Standards Australia, such as engaging the industry in the standards development process for both new and emerging areas as well as the existing areas, exploring new areas of standards such as services standards, ensuring active participation in ISO and IEC and in technical committees, and growing the next generation of people to be involved in standards work.

NMIA. A few strategic issues that NMIA is proactively addressing include reviewing the regulatory burden on business, staff demographics, challenges presented by constrained resources, technology changes and stakeholder expectations.

NMIA recognises the changing Australian industry landscape, e.g. the decline in manufacturing activity and the shift from manufacturing to services, with consequent impact on its service delivery. NMIA also recognises the challenges presented by a high value knowledge based industry and as such is focusing on building skills and capabilities to address future needs in the context of these changes.

NATA: Survival of accreditation bodies depends on their relevance, so NATA has to ensure that their services remain relevant to the economy. This is achieved through a comprehensive stakeholder relations programme that includes major industry groups and government at federal and state levels. There is less direct specification of accreditation and the tendency now seems to be that the industry body drives the demand rather than the government. The nature of work is shifting, for instance, health, food, and agriculture are growing in importance. In the area of food, there is more demand from the importing side, for instance to ensure the safety of produce.

The transition to a knowledge based economy is also creating challenges. NATA used to receive a lot of requests from manufacturing sector but it is no longer the case. This has also meant a deskilling in some areas such as materials, whereby due to the decline in manufacturing there has been a loss of specialist knowledge in these sectors (which creates difficulties when understanding and testing imported products). This transition also means that there is a need to keep up with new innovations and trends such as the Fourth Industrial Revolution.

There are also changes in laboratories, where in some cases there are declining skill levels and government's retreat from running laboratories. Laboratories now tend to offer more services and are becoming larger. Hence, while the number of laboratories is decreasing, they are increasing in size.

JAS-ANZ. JAS-ANZ recognises that standards development can at times be too slow to adapt to technological advancements. Further, the increase in global trade and internationalisation of

modern supply chains has also increased the complexity and reliance on conformity assessment outcomes, which adds additional challenges for accreditation bodies. As such, there is a need for accreditation bodies to be agile and evolve to remain fit for purpose and relevant to market needs. In certain circumstances, the approach should be to work from a problem, not a standard, and to identify solutions to the problem. As an accreditation body, JAS-ANZ has a key leadership and trade facilitation role in educating businesses, certifiers, suppliers, government and trading partners; and the way in which it remains agile and relevant is critical to ensuring the quality of the wider standards and conformance infrastructure.

Conclusion and Way Forward

There are some unique features in the S&C infrastructure in Australia – such that most of the key S&C organisations sit outside of government. While structured in this way, there is a strong level of oversight by, and cooperation with government through DIIS, which allows strong collaboration, efficiency and innovation between the key S&C bodies and government.

Australia's S&C infrastructure works proactively to serve the needs of Australia and provide the essential framework for industry and government to maintain domestic and foreign confidence in its goods and services. Going forward, strong collaboration is important so the framework ensures not only that goods and services are safe but also to enhance Australia's global competiveness, attract investment and support innovation.

As such, the Australian Government places a high importance on how the S&C system can drive trade facilitation, while maintaining safe products for consumers. The way in which Australia's S&C infrastructure works together, with government and industry is crucial to the effective operation of the S&C system and ensuring it meets the needs of industry and consumers while not creating unnecessary barriers to trade.

CHINA

Overview of Standards and Conformance (S&C) Organisations in China

China has a number of government organisations, industry associations and affiliated agencies that are related to S&C systems either directly or tangentially. The main standards and conformance agency is General Administration of Quality Supervision, Inspection and Quarantine of the People's Republic of China (AQSIQ), a ministerial administrative organ directly under the State Council of the People's Republic of China. It is a relatively large organisation in charge of national quality, metrology, entry-exit commodity inspection, entry-exit health quarantine, entry-exit animal and plant quarantine, import-export food safety, certification and accreditation, standardisation, as well as administrative law-enforcement.

Organisations interviewed in this case study are related to AQSIQ either as 1. in-house departments, 2. direct affiliates or 3. independent associations attached to AQSIQ. The two main wings that carry out the duties of AQSIQ are the Certification and Accreditation Administration of the P.R. China (CNCA) and the Standardisation Administration of the P.R. China (SAC). While SAC and CNAC are still under AQSIQ, they have full authority to deal with other ministries. A third important agency is the Department of Metrology which organises the implementation of metrological laws and regulations to coordinate measurements used in standardisation. SAC is the central accrediting body for all activity related to developing and promulgating national standards in China, and also represents China in the International Organisation for Standardisation (ISO), the International Electrotechnical Commission (IEC) and other international and regional standardisation organisations. CNCA is primarily in charge of administrating the China Compulsory Certificate (CCC), and certifies other institutions to provide CCC marks. It also supervises testing laboratories and inspection bodies.

As a centrally organised economy, government agencies in China do not have much overlap, and there are clear delineations of responsibilities. For instance, China is one of the few economies with a unified accreditation body, China National Accreditation Service for Conformity Assessment (CNAS), which is responsible for the accreditation of certification bodies, laboratories and inspection bodies.

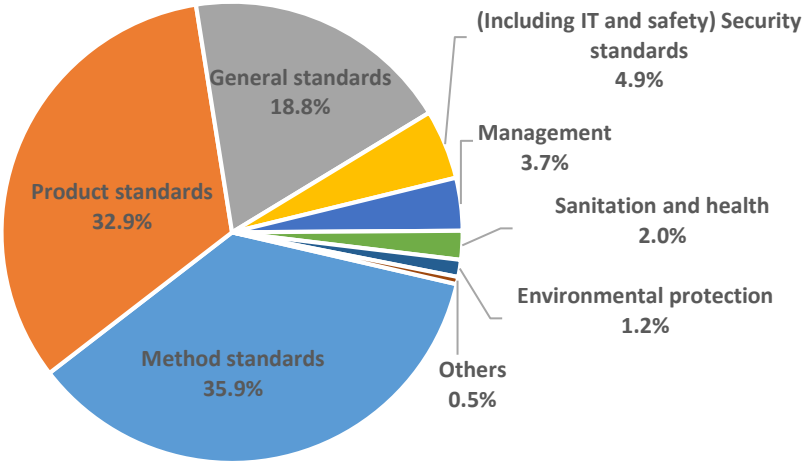
There are also various non-profit research organisations involved in standards and conformity assessment affiliated to AQSIQ. These affiliated institutes function like think-tanks, providing services to the government. For instance, China National Institute of Standardisation (CNIS) does research on the development of standardisation, metrology and other relevant areas. It should be noted that these institutions are involved only in the research aspect, while policymaking is left to official government departments under AQSIQ. However, they do receive funding and direction from AQSIQ. Associations such as China Certification and Accreditation Association (CCAA) and China Metrology Association (CMA) play an additional role of bridging industries with the government agencies.

Number of Standards

The number of standards developed in the last three years are generally similar. In 2014, there were 1,530 voluntary and mandatory standards, 1,931 in 2015 and 1,763 in 2016. In total, there are 33,853 national standards, of which majority (29,874) are voluntary and not strictly enforced. Instead, they are taken as recommended guidelines for industries. The other 3,979 standards are mandatory. Companies themselves may also have their own internal standards,

which are more stringent than national level (GB) standards. The breakdown of national standards by type is shown in Figure 11 below.

Figure 11: Type of National Standards



Source: Interviews by PSU

Number of Laboratories

Due to the large number of testing laboratories and certification bodies in China, private sector involvement comprises of both board membership as well as regular consultations. About half of the laboratories are privately owned, and the other half state owned. To date, there are about 33,000 laboratories in total, which issue over 300 million certificates. These laboratories can span a range of industries: construction and building, environment, automobile, food, water quality, forestry and fishery agriculture, sanitary measures, information technology (IT), textile, chemical and medical. In 2015, the CNAC had the following number of laboratories:

Figure 12: Laboratories Owned by CNAC in 2015

Industry	Number
Construction	7012
Food	3353
Sanitary	1739
Agriculture, forestry, fishery	1548
IT	438

Source: Interviews by PSU

Certification Bodies

There are 351 certification bodies in China, issuing over 1.7 million certificates in total.

Metrology Institutes

In total, there are 193 metrology institutes, which provided over 300 certificates in 2016. There are both public and private metrology departments, and funding therefore differs according to the type of institute. Public metrology institutions are funded using public funds, while private institutes may receive funding from the national budget, but they generally have their own funding sources. Some metrology functions of government organisations may be outsourced to specialised centres, because of inadequate resources in the main department.

Funding

The main source of funding for government standards and conformance bodies come from the national budget. The government has recently focused on scientific research, and provides funds to the relevant agencies to advance their work. Funding may originate from specific ministries. For instance, the Ministry of Science and Technology provides funds to the Department of Science and Technology under AQSIQ. However, while the management and operation of government bodies are funded via the national budget, standards development may involve private enterprises or universities with their own sources of funding. Government agencies may also be self-funded in some cases. For instance CNAC is self-funded and earns revenue from their accreditation services. Certification bodies are similarly diverse, but are mainly self-supported.

The 15 direct affiliates of AQSIQ will receive funding from them, but may have other sources such as scientific research funds, funding from the budget of key national projects and revenue from procuring government projects. Certification bodies such as China Quality Certification Center (CQC) and Chinese Society for Measurement (CSM) may also generate revenue from their business. As such, sources of funding depend not only on an organisation's relation to the government (an in-house department of AQSIQ, a direct affiliate, or an industry association), but also on its function.

Key Performance Indicators

In-house departments and direct affiliates of AQSIQ generally have a performance index tracked by AQSIQ, with multiple reviews annually. Furthermore, there could be other indicators used to gauge an organisation's performance. China National Institute of Standardisation (CNIS) is assessed according to areas like achieving research outcomes or winning awards, participation in international standardisation activities and holding key positions in committees, in addition to achieving an annual target set at the beginning of each year.

Departments such as the Department of Supervision on Inspection have quantitative KPIs such as the rate of acceptance of a product during sample checking. The rate of acceptance was 17.4% in 1993, but has risen significantly to 91.1% in 2015, indicating a marked improvement of product quality in China. The department also collects indicators such as consumer satisfaction, but these are not quantitatively measured. Some organisations interviewed also mentioned that they track their performance via their impact on public welfare, which may not be quantifiable.

Private Sector Involvement

Many organisations have a dedicated day to commemorate an aspect of standards and conformance in China. SAC conducts outreach programs such as Standards Day, where they carry out promotion activities and publish booklets to increase public awareness of the

importance of standards. Interviewees indicated that there has been an increasing level of interest amongst the industry. In the past, the government had to approach enterprises to participate in Standards Day; currently, private firms are approaching the government regarding issues like guidance on international standards and training courses. CNAC organises a "Quality Month" every September and also organises World Accreditation day on 9th June, with different events in different provinces. These events target both the public and specific industry sectors, depending on the nature of the event. Events for "World Metrology Day" are organised on 20th May, where the department of metrology will organise events in different provinces in China. The target audience is the general public, but services are advertised to students and industries.

Another approach for soliciting public feedback is via websites. Agencies such as CNIS, CNAS and CNAC have feedback mechanisms in place to address issues raised by the public, and some have strict deadlines to respond to these requests. Associations like CCAA and CMA additionally publish magazines to promote international standards and best practices to industries.

Besides having open channels of communication, government agencies may directly consult the private sector during the policy-making process. In SAC, the private sector is consulted during standards development, even though the standards themselves are ultimately approved by government agencies. Some standards could also have originated from enterprises, in response to the changing needs of the industry. However, they note a unique issue in the case of China, where the definition of "private sector" may refer to both private firms and state-owned enterprises (SOEs).

Organisations that interact directly with private firms may also receive feedback over the course of their work. The Research Centre for International Inspection and Quarantine Standard and Technical Regulation provides guidance and legal support on standards and conformance assessments to enterprises who want to access foreign markets, and may receive feedback during their sessions. Associations such as China Certification and Accreditation Association (CCAA) and China Association for Standardisation (CAS) aim to bridge differences between the industry and the government, and may also relay public feedback to AQSIQ.

International Engagement

Most organisations and government institutes interviewed were involved in international cooperation activities. These could range from bilateral agreements, technical cooperation or participation on the boards of international committees such as ISO and IEC. As mentioned previously, SAC represents China in the International Organisation for Standardisation (ISO), the International Electrochemical Commission (IEC) and other international and regional standardisation organisations. The WTO TBT Agreement Code of Good Practice are also adopted by key departments like SAC and CNAC.

Most MRAs are between governments, rather than certification bodies. In total, China has MRAs regarding standards and conformance with around 20 economies such as USA; the UK; France; and the economies participating in the One Belt One Road (OBOR) initiative. They also have multilateral MRAs that cover 13 fields such as food products, environmental standards, medical testing and calibration of equipment. Their multilateral MRAs span a much wider spread with 93 economies, covering over 95% of the total trade volume of the world economy.

China frequently looks to best practices of international partners to guide its own reform. Harmonising national standards to international ones are also essential for projects such as OBOR. Exchange of information with international experts is also often cited as a benefit of international engagement by interviewees. An interviewee noted that China often looks to Western economies such as the US; Canada; and the EU to guide their areas for improvement. However, they believe that China could benefit from widening their scope to include developed Asian economies in APEC such as Japan or Korea.

Box 1: Examples of International Collaborations

The Department of Metrology has bilateral agreements with European institutions such as in the Netherlands, Germany, Switzerland and the United Kingdom regarding measuring instruments. These arrangements can prevent redundancy and reduce the time to trade, as well as costs.

The Department of Science and Technology has government collaborations with the US and Canada. There are also projects on "geographical indicators" (地理指标) within the Southeast Asian and South American region.

CNIS actively participates in international committees such as ISO. It has 46 members in ISO, which include key positions such as Chairperson. They also apply for projects under international organisations such as UNDP, UN-Energy, etc. As a result of such engagement, CNIS has increased their research capacity and influence through undertaking such technical work on international level. Besides receiving support, they have also provided technical assistance to other economies.

The Department of Supervision on Product Quality looks to collaboration with developed economies such as the US; EU; Japan; and Korea to develop best practices regarding safety standards of imported products.

The China Special Equipment Inspection and Research Center (CSEI) has numerous collaborations with the ASME (American Society of Mechanical Engineers) in areas such as developing energy saving products, on UNIDO projects, as well as being credited to provide certification. CSEI additionally works with ISO to ensure compliance, and is looking to have more Chinese steel being accepted under ISO standards.

CMA has bilateral cooperation with the Asia-Pacific Legal Metrology Forum (APLMF). They also work on projects such as the legal aspect of metrology with Germany, safety in the mining industry with South Africa and technical cooperation with Canada.

CSM represents China in the International Measurement Confederation (IMEKO), which is a non-governmental federation of 42 Member Organisations who aim to advance measurement technology. CSM also cooperates with Japan and Korea at an annual measurement associations meeting.

CAS is involved in North East Asia Standards Cooperation Forum (NEASF), Pacific Asia Standard Congress (PASC), IFAN and other bilateral cooperation activities. They also support SAC's international cooperation engagements.

Source: Interviews by PSU

Benefits of Standards

Firms in China have benefited from standardisation mainly from an increase in consumer confidence, and the opportunity to facilitate imports and exports with international firms through common requirements.

A study by Mangelsdorf (2011) found that adopting international harmonised standards increased bilateral trade between China and the EU. Standards create a "common language" that facilitates trade between economies, and also act as a quality signal for brands that may not be internationally recognised. However, there was some asymmetry with regards to national standards. Chinese importers tended to trust European standards more than European standards trust Chinese standards.

A specific example is the Dalian Shipbuilding Industry Corporation, which has benefited from its use of international and national standards such as Conventions of the International Maritime Organisation (IMO), ISO standards (ISO 9001, ISO 14001 and standards of ISO/TC 8), National GB standards, Chinese industry-sector standards for the shipbuilding industry and other technical regulations required in China (ISO, 2014). It is a state-owned shipbuilding corporation that has operations spanning five industries: shipbuilding, defence, ocean engineering, ship repair (including shipbreaking) and heavy industrial manufacturing. Standards use allows the firm to generate economic benefits amounting to RMB 13.3 million (USD 2 million) annually, mainly due to cost savings from information sharing between the company and the suppliers. Other benefits include reducing design errors and improving safety measures, increasing customer confidence, reducing negotiation time because of common standards usage, and increasing the ease of cooperation with different suppliers.

Additional Support Required

Many interviewees cite funding and manpower as areas that they would like additional support from the central government. Departments can vary widely in size from less than 20 to over a thousand staff members, depending on their functions and how much funding they receive from the government. For instance, the Department of Supervision on Inspection has 551 testing centres in the 31 provinces to implement product quantity work. However, there are only 19 staff managing this work, and a department can be as small as three people who take on multiple roles. Organisations such as China Special Equipment Inspection and Research Center (CSEI) also indicated that they specifically require more technical staff like researchers on their team. An interviewee mentioned that China's main focus currently is to develop a unified structure on conformity assessment. As a geographically large economy, establishing a national certification scheme in China requires a large amount of resources for standards to be both advanced and widely applicable throughout the economy.

Two reasons for the increasing pressure felt by standards organisations are the increase in trade volume in China, and the increase in new types of products which will require new standards and more exact measurements to be developed. The Department of Supervision on Product Quality noted that the steadily increasing trade volume in China has put pressure on the department. There was a seven-fold increase in trade revenue between 2001 and 2008, with trade revenue reaching over 4 trillion USD in 2016. However, this issue is not unique to China, and the lack of resources to deal with high trade volumes occurs in other economies as well.

Future Direction

Standards organisations interviewed appear to place high importance on anticipating future needs of standardisation in China. For instance, standardisation reforms issued by the State counsel of China were carried out in 2015 to ensure the long term sustainability of standards use in the economy. Five-year plans also guide the direction for most government agencies' work.

Earning the Trust of Consumers

One common theme mentioned by those interviewed is earning the trust of consumers regarding the ability of standards and conformity assessments to protect them from fake products. For instance, CNAC wants to increase awareness of the benefits of certification and accreditation to consumers and industry players, as well as to other government agencies. They raised the issue of quality marks on food products in the supermarket as an example of this.

An important project of CNAC is developing a unified system for certifying "green" products with environmentally friendly properties such as energy conserving, low current, and non-hazardous to the environment. There are currently many "green" certification schemes run by different ministries, which may be confusing for consumers. A unified "green mark" would streamline standards and also provide greater clarity for consumers.

Addressing the Needs of the Market

SAC carried out standardisation reforms in 2015 to ensure the long-term sustainability of standards use in the economy. These reforms had three main objectives: 1. Establish new market-driven standards, 2. Improve relations between government and the market, and 3. Improve public participation in standards development. There were a number of initiatives done to realise these reforms. Firstly, a "coordination mechanism" was implemented between government agencies to improve efficiency. Secondly, the government sought to integrate and streamline mandatory standards, to minimise the number of standards. This integration addresses the conflict between national and local (provincial) standards which was raised by private companies. Outdated standards were also identified and removed in this streamlining. Additionally, CCAA mentioned that procedures have become less bureaucratic as forms that previously had to be submitted in hard-copy can now be done online. Another association, CMA highlighted the benefits of considering public sentiment from the industries, and incorporating this feedback into the policy making process.

An interviewee mentioned that they would like to see more innovation in the aspects of certification and accreditation. While they recognise that this may be challenging in a centralised economy, they would still like to see new services being developed in response to future needs. There is therefore a need to balance a strong but fair regulative framework with encouraging innovative development. Additionally, CNIS (China National Institute of Standardisation) as a national research institute believes that more can be done in translating research outcomes to implementation on the ground. An innovative type of research has been undertaken in China to measure the contribution of accreditation and testing to GDP. Part of this is monetary value in the form of payments, but it also includes the value gained by firms and society as a whole as a result of accreditation. More of such initiatives could advance standards and conformance assessments in the economy.

China has also been working on improving the transparency of the system. In the case of the Department of Supervision on Inspection, it is currently utilising a process of "double random checking". Previously both the testing agency and firm to be tested were nominated, but now both are chosen at random.

Improving International Standing

Many institutions mentioned that they would like to improve the international perception of China's standards institutions, especially when compared with their European or American counterparts. The Department of International Cooperation noted that that Chinese certificates are often not regarded as highly as other international certificates. As such, they hope that local standards and certification will eventually be regarded on par with international standards in the future.

China Inspection & Quarantine (CIQ) also mentioned that they hoped to promote Chinese inspection institutions, as the market is currently dominated by European institutions. The lack of Chinese institutions increases the cost of inspection for domestic firms, as they have to fly products to be tested in Europe, rather than testing locally.

Concluding Remarks

In general, S&C in China is highly organised due to the centralised nature of the economy, but also has channels for public engagement. Organisations place high values on international engagement, as they see this as an avenue for adopting best practices, and exchanging information with other experts. This is evident in the number of bilateral cooperation projects as well as the level of participation in committees such as ISO and IEC.

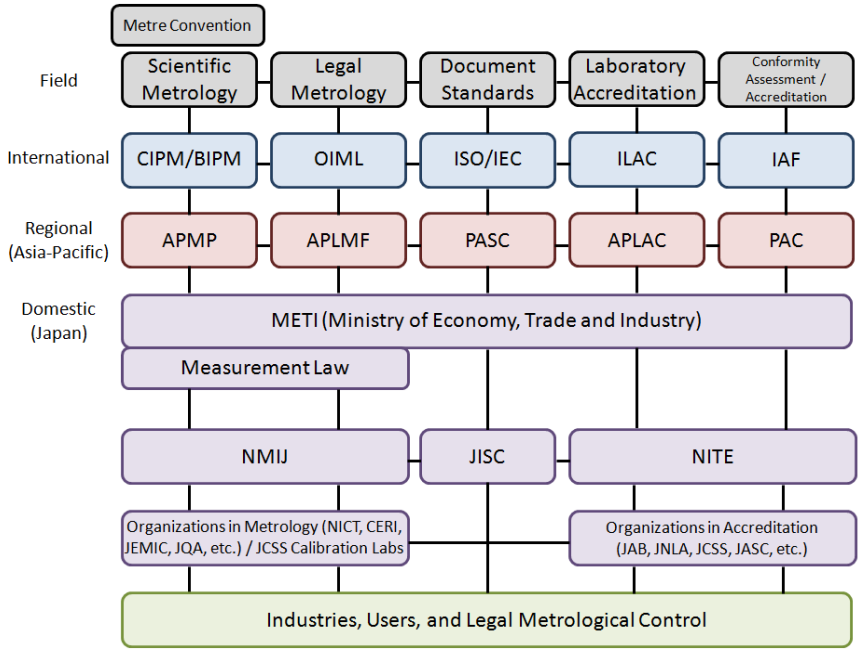
Moving forward, the economy can benefit from providing more room for innovation and perhaps allocating more funds and manpower to agencies which have to cope with the significant increase in trade volume. Having closer, systematic, and regular engagement with grassroots—i.e., suppliers, producers, consumers, and other stakeholders—will also help the S&C infrastructure to be more responsive to the needs of the market and adjust to rapid changes in a timely manner. Educating and earning the trust of consumers is also an issue for this economy, although steps have been taken by various agencies to do so.

JAPAN

Overview of Standards and Conformance Infrastructure in Japan

Japan has an advanced level of quality infrastructure supported by established standards and conformance bodies that adhere to international best practices. Overall, standards and conformance infrastructure in Japan is characterised by a high level of engagement with the private sector, a high degree of collaboration among the various bodies, and a high level of international engagement. Figure 13 provides a graphical representation of the standards and conformance infrastructure in Japan.

Figure 13: Overview of Standards and Conformance Infrastructure in Japan



Source: Adapted from a presentation made by the National Metrology Institute of Japan (NMIJ).

Standards Setting Process

The Japanese Industrial Standards Committee (JISC), whose secretariat is placed in the Ministry of Economy, Trade and Industry (METI), is the body responsible for setting standards. The standards setting process in Japan is rather inclusive, involving early consultation with end users of the product (whether businesses or the general public) as well as academia and other technical experts. Ministry involvement is usually minimal at the beginning of the process. Thus, practically all of the standards that are proposed to JISC are subsequently recommended as standards. New standards or revisions to current standards can be proposed by either industry or the government. Each year, around 90% of standards proposals are requested by the industry[31].

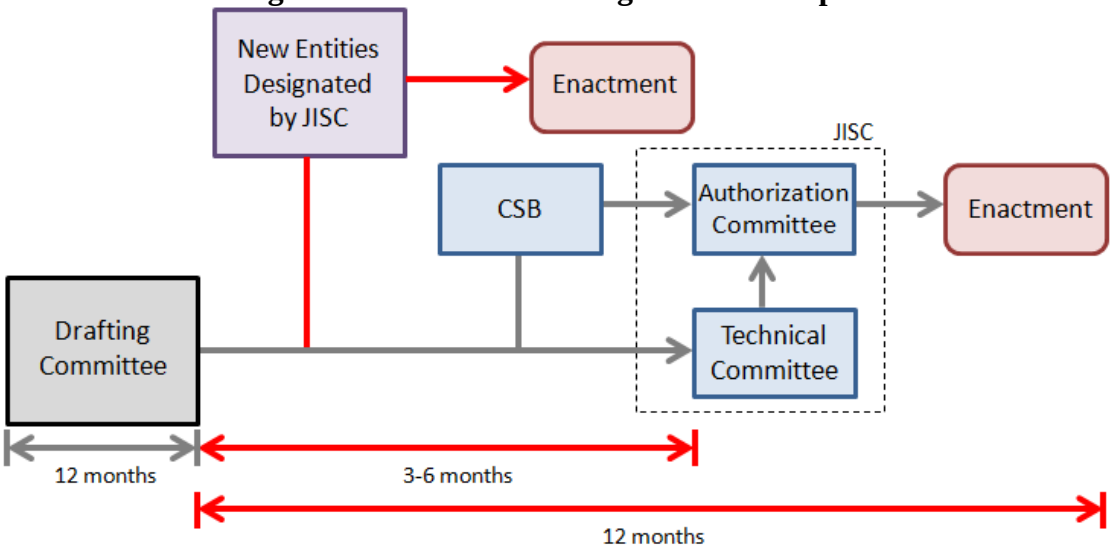
Normally, a draft standard is deliberated by a technical committee and an authorisation committee of JISC before it is enacted. The standards setting process in Japan also allows for a certified standardisation body (CSB) to offer deliberation, thereby bypassing the JISC technical committee so that standards can be enacted more quickly. However, there are only

[31] There are about 300 industry organisations in Japan, each with a technical committee.

three CSBs which have been approved by JISC and this accelerated standards-setting process is seldom used. Thus, this year JISC will submit a draft revision of the Industrial Standardisation Act (which regulates the standards-setting process), that aims to enable the private sector to be even more active and responsible in setting standards, to the Parliament, thereby making the process faster and easier.

The main features of the revision are to accelerate the standards development process and to expand the scope of standards into the services sector. Currently, the process from proposal to issuance of a standard takes around one year; JISC plans to reduce this period to three to six months. Under the revised law, JISC will designate new entities which will have the responsibility to enact standards, thereby enabling those companies that operate in more innovative sectors to enact standards more quickly illustrates how the standards-setting process in Japan will operate under the revised law, which is expected to go into effect in 2019 following parliamentary deliberation in 2018.

Figure 14: Standards Setting Process in Japan



Source: Adapted from a presentation made by the Japanese Industrial Standards Committee (JISC).

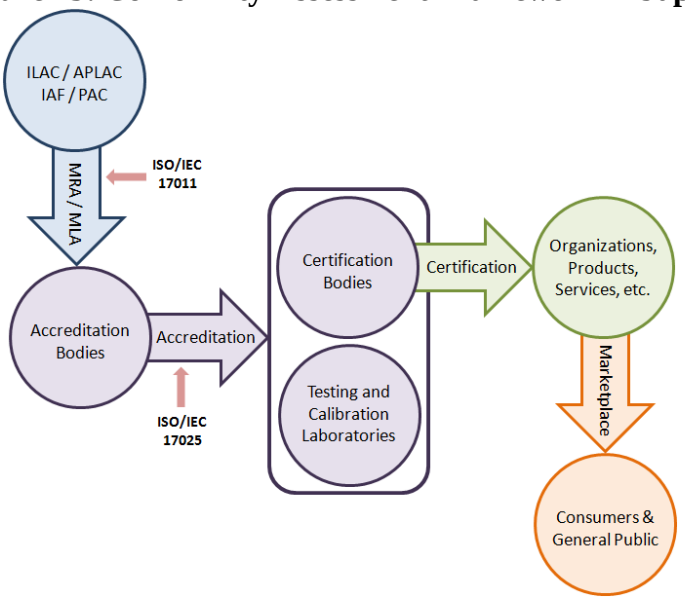
Standards in Japan are referred to under the Japanese Industrial Standards (JIS) scheme. Each year, there are over 500 standards activities, with around one-third being the development of new standards. In fiscal year 2016, a total of 517 JIS were developed: 159 new standards and 358 revised standards. Of these 517 JIS, 475 were proposals from industry and 42 were proposals from the government. As of March 2017, there were a total of 10,616 active JIS, over half of which (5,839) correspond to international ISO/IEC standards. Of those, 97% (5,683) are considered to be harmonised with international standards, with 38% (2,256) being identical and 59% (3,427) being modified.

Similar to other economies, standards in Japan are voluntary until they are referenced in legislation, at which point they become mandatory (technical regulations). As of 31 December 2016, there were 7,529 citations of JIS in 206 laws and regulations in Japan. The main Japanese laws and regulations referencing JIS include the Act on Securing Quality, Efficacy and Safety of Products including Pharmaceuticals and Medical Devices (1,349 JIS references); the Fire Services Act (640 JIS references); and the Building Standards Act (604 JIS references).

Accreditation and Certification Process

The conformity assessment framework in Japan is shown in Figure 15. The accreditation and certification process in Japan is well-established and is supported by many accreditation bodies, testing and calibration laboratories, and certification bodies. With the exception of two public accreditation bodies, all of the other accreditation bodies, certification bodies, and testing and calibration laboratories in Japan are operated by the private sector. Conformity assessment bodies must periodically undergo the accreditation process according to the relevant standard such as ISO/IEC 17025, while accreditation bodies must undergo assessment based on ISO/IEC 17011 every four years in order to maintain their status as MRA/MLA signatories.

Figure 15: Conformity Assessment Framework in Japan



Source: Adapted from the Japan Accreditation Board (JAB) Annual Report FY2015.

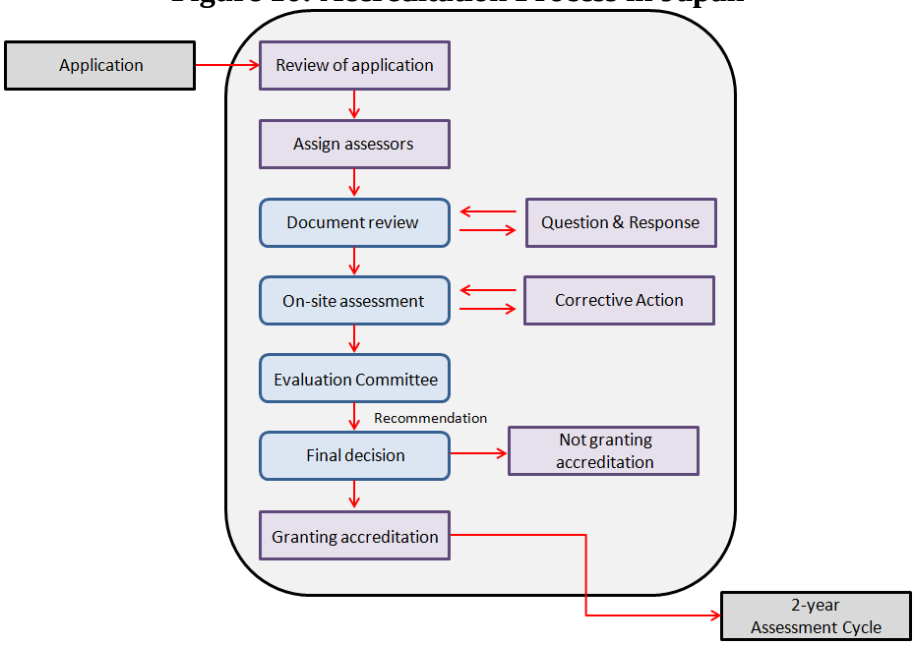
There are five accreditation bodies in Japan that are members of ILAC/APLAC/IAF/PAC. International Accreditation Japan (IAJapan) within the National Institute of Technology and Evaluation (NITE) is a government agency that administers four accreditation programs: 1) Japan Calibration Service System (JCSS) for calibration labs seeking measurement traceability; 2) Japan National Laboratory Accreditation System (JNLA) for testing labs seeking conformance to JIS; 3) Accreditation System of National Institute of Technology and Evaluation (ASNITE) for testing labs, calibration labs, reference material producers, and product certification bodies seeking conformance to international standards and requirements; and 4) Measurement Laboratory Accreditation Program (MLAP) for environmental labs seeking conformance to legal requirements.

Japan Accreditation Board (JAB) is the largest accreditation body in Japan and was established in 1993. It is a private agency that provides the widest scope of services in Japan, covering nine fields of accreditation ranging from management system certification bodies to medical laboratories. The other three accreditation bodies are Voluntary EMC Laboratory Accreditation Center (VLAC), a private agency that specialises in conducting assessments of testing laboratories in the electromagnetic compatibility (EMC) field; Japan Accreditation System for Product Certification Bodies of JIS Mark (JASC), which is operated by METI; and ISMS Accreditation Center (ISMS-AC), a private body that provides accreditation mainly for information management system certification bodies.

In Japan, there has been an increasing trend for accreditation requests from medical laboratories (ISO 15189) due to a recent change in the public health insurance system. Accreditation requests from product certification bodies (ISO/IEC 17065), particularly for food safety, are also increasing due to the development of a new conformity assessment system for agricultural products, Japan Good Agricultural Practice (JGAP), by the Ministry of Agriculture, Forestry and Fisheries (MAFF) in order to promote food exports from Japan. Although accreditation requests from ISO management system certification bodies are very popular in Japan, the number of certifications is falling due to many companies, especially SMEs, still making the large changes required under the 2015 revisions of ISO 9001 and ISO 14001.

The accreditation process in Japan fully complies with international standards (ISO/IEC 17011). A graphical representation of the process is shown in Figure 16. Although it can vary depending on the conformity assessment body that is being assessed, the entire accreditation process – from making an application to receiving accreditation – can take around three to six months. As of June 2017, there were 1,050 conformity assessment bodies in Japan that had received accreditation from one of the five accreditation bodies which are members of ILAC/APLAC/IAF/PAC.

Figure 16: Accreditation Process in Japan



Source: Adapted from a presentation made by International Accreditation Japan (IAJapan).

Although there are some similarities in the services provided by the accreditation bodies in Japan, each has a specific role in the accreditation system. Moreover, since there are several accreditation bodies in Japan, there is also a degree of competition among them, which helps to keep costs affordable. Nonetheless, customer feedback indicates that more progress can be made to reduce costs and shorten the time it takes to complete an assessment. To achieve this, for instance, JAB is researching ways to improve its IT system so as to reduce administrative costs as well as exploring the possibility of remote assessment for some parts of the accreditation process.

There is also close collaboration among the accreditation bodies in Japan. The Japan Accreditation Council (JAC) was established in 2006 in order to help increase the reliability of

conformity assessment systems throughout Japan. JAC allows the accreditation bodies to share accreditation experience as well as to improve the technical competence of the bodies and promote accreditation to the market. Its members include the five accreditation bodies in Japan with several other agencies having observer status. JAC meets several times a year and its secretariat is based at IAJapan.

In addition to there being hundreds of accredited testing and calibration labs, there are also dozens of accredited certification bodies in Japan. More specifically, there are over 65 facilities that provide certification of management systems (ISO/IEC 17021), nearly 40 that provide product certification (ISO/IEC 17065), and three that provide certification of personnel (ISO/IEC 17024). Although some certification bodies specialise in particular sectors such as textiles or chemicals, there are also similarities in some of the services provided by the certification bodies. Thus, there is strong competition among the certification bodies in Japan, which helps to keep costs down for businesses seeking certification.

The JIS Marking System can be used as an example to illustrate the certification process in Japan. Those bodies that provide certification for JIS Mark must be compliant with ISO/IEC 17065 in order to be accredited. The certification process then performed by these accredited certification bodies consists of two elements: 1) evaluation of whether the product is in conformance with the criteria of the relevant JIS and 2) evaluation of whether the quality management system of the manufacturer meets the requirements of the JIS Act. Manufacturers of products that conform to these standards can receive certificates of conformity and can then put the JIS Mark on those products.

Japan Quality Assurance Organisation (JQA) is one of the largest bodies providing certification services to companies in Japan. It began in 1957 as a non-profit inspection agency connected to METI (under the laws concerning public interest corporations). Over 20,000 companies are served by JQA with about 60% of its total revenue coming from ISO management system certifications. The time it takes for product certification ranges from around three to six months. However, in the case of highly technical products, such as personal care robots, the certification process can take up to one year. Through bilateral agreements, JQA has a global network that enables it to offer certification services for management systems and/or testing and certification of electrical and electronic products in 46 economies around the world.

The accreditation and certification process as well as standards-setting in Japan is supported by well-established metrological infrastructure. The principal metrological institution in Japan is the National Metrology Institute of Japan (NMIJ) within the National Institute of Advanced Industrial Science and Technology (AIST). NMIJ is responsible for scientific and legal metrology, enabling and ensuring a traceability system whereby all measuring instruments in Japan are traceable to national measurement standards. NMIJ also offers calibration services, currently providing around 800 calibration reports and 2,000 certified reference materials (CRMs) to industry annually.

Product Safety and Market Surveillance

Product safety regulations in Japan are an important component to ensuring the quality of products in the market. A measurement barrier for the safety of a product (e.g., voltage) is determined at the technical level, thereby requiring mandatory adherence once a particular standard has been referenced in legislation. Third party conformity assessment is permitted and a PS Mark is received when a product meets the technical regulations. There are currently 491

products that fall under one of four laws that regulate product safety in Japan: Electrical Appliances and Materials Safety Act (457 products); Gas Business Act (8 products); Act on the Securing of Safety and the Optimisation of Transaction of Liquefied Petroleum Gas (16 products); and Consumer Product Safety Act (10 products). The Product Safety Department within METI provides information and support concerning product safety regulations for companies operating in Japan.

To ensure that products in the marketplace conform to mandatory standards, the Product Safety Department funds and instructs other agencies to conduct market surveillance. The designated agency submits products they have purchased in the market to testing in order to determine whether they are in compliance with the relevant technical standards. Based on the findings of the investigation, the agency will then make a recommendation to METI. If a violation is found as a result of the inspection, METI will provide the supplier with guidance on improving the product or procedures in order to remove the illegal status. If necessary, METI demands reports and performs on-site inspection of suppliers.

A KPI for the Product Safety Department is to reduce the number of serious product accidents each year. In 2016, there were 802 serious accident cases (compared with 885 in 2015). The Consumer Affairs Agency requires that all serious product accidents are reported and shared with METI, which are then investigated by NITE. NITE then provides a recommendation to METI based on their investigation (e.g., a recall notice for the product should be issued). Currently, only serious accidents must be reported; however, the Product Safety Department is trying to widen the scope of reporting to include non-serious product accidents (near misses, burns, etc.) as well as reporting of accidents that are caused by the user.

The Product Safety Department is also currently trying to enhance the promotion of information in other economies since foreign companies may not be entirely aware of the regulations regarding product safety requirements in Japan. In addition, companies can receive the PS Mark for their products outside of Japan through third party conformity assessment bodies located in other economies. METI currently recognises about six bodies outside of Japan, including in China; Hong Kong, China; and Chinese Taipei, which can provide certification services for the PS Mark.

Resources Available

The standards and conformance infrastructure in Japan is well-funded and without staffing issues, with many of the larger accreditation and conformity assessment bodies maintaining offices throughout Japan. Nearly all of the accreditation and certification bodies in Japan are operated by the private sector, with JAB (the largest accreditation body) and JQA (the largest certification body) operating as non-profits under the laws concerning public interest corporations.

JISC, which is fully funded by the government, has a budget of nearly JPY 12 billion, excluding salaries, for the fiscal year 2019. This budget is divided across four main areas: enhancing strategic standardisation; enhancing standardisation to strengthen industry; management of NITE; and implementation of measurement administration. JISC has approximately 100 staff, with about 30 involved in metrology, and about 70 working in three main divisions: Technical Regulations, Standards and Conformity Assessment Policy Division; International Standardisation Division; and International Electrotechnology Standardisation Division.

IAJapan operates as incorporated administrative agency and receives partial government funding for its activities. Through NITE, IAJapan receives funding from METI as well as through fees charged for its accreditation services. Its total annual budget is JPY 1 billion, with about 10% to 20% coming from fees. However, the Japanese government requires that NITE reduce the budget allocation received from the government by 1% to 3% each year. Therefore, IAJapan must continue to look for alternative sources of funding by, for instance, widening the scope of services it provides. As of May 2017, IAJapan had a staff of 100.

NMIJ has also operated as an incorporated administrative agency since 2001 and receives government funding from METI through AIST as well as funding from the private sector in order to conduct collaborative research. The commissioned research budget of AIST is currently JPY 20 billion, with around JPY 13 billion provided by the government and JPY 7 billion coming from the private sector. A current KPI for AIST is to increase its collaboration with private companies with the goal of increasing the budget it receives from the private sector by three times by 2020. As of April 2016, NMIJ had 557 personnel, including 292 researchers.

Many of the respondents interviewed for this case study emphasised the importance of having highly-trained staff, especially considering the technical expertise that is often required of accreditation assessors. In fact, there is an emphasis on training among the standards and conformance bodies in Japan. For example, IAJapan provides a 1-week assessor training course. Meanwhile, VLAC also offers additional in-house training given its highly technical field of assessment. In addition, NMIJ has the Metrology Training Center which helps to train metrology-related personnel of local prefectural and city governments within Japan.

International Engagement

Japan is a member of all the international forums relating to standards and conformance and a high level of international engagement is a key feature of its quality infrastructure. JISC is an active ISO member, participating in 755 committees, including being a permanent member of the ISO Council and the Technical Management Board (TMB). JISC also participates in over 190 IEC committees, including as a permanent member of the Council Board (CB), the Standardisation Management Board (SMB), and the Conformity Assessment Board (CAB). Japan is among the top five economies proposing new ISO/IEC standards, together with Germany; the United States; France; and the United Kingdom. In 2016, JISC made 103 new proposals for international standards, a number that has steadily risen over the past 10 years.

The main accreditation bodies in Japan – IAJapan, JAB, and VLAC – are all members of ILAC and signatories to the ILAC MRA, while IAJapan and JAB are also members of IAF and signatories to the IAF MLA. These agencies are also active members of the APLAC and PAC regional accreditation organisations. Through these forums, JAB and IAJapan conduct peer reviews and engage in capacity building throughout the region, which also gives them an opportunity to share best practices. In addition, IAJapan staff is on the APLAC Board of Management and the current Chair of the APLAC Public Information Committee, while JAB staff is the current Chair of the PAC MLA Management Committee.

Regarding metrology, NMIJ is a member of CIPM and OIML and a signatory to the CIPM Mutual Recognition Arrangement (MRA). Through its participation in the MRA, Japan and other economies recognise the degree of equivalence of national measurement standards[32].

[32] Signatories of the CIPM MRA include representatives from 102 institutes and covers a further 155 institutes designated by the signatory bodies.

Since many large manufacturers in Japan measure product quality using their own instruments, NMIJ can test and accredit the calibration of those instruments according to ISO 17025. Thus, the certification provided by NMIJ ensures that the quality of the product has been measured according to traceable and recognised standards, helping to facilitate exports for the company through the CIPM MRA. Through the APMP and APLMF regional forums, NMIJ also participates in and conducts various activities such as information exchange and training programmes. (NMIJ currently hosts the APMP Secretariat.) In addition, NMIJ has recently increased its collaborative efforts with Australia; China; Korea; and Thailand.

The Product Safety Department of METI is also a member of several multilateral organisations, including the International Consumer Product Health and Safety Organisation (ICPHSO) and the International Consumer Product Safety Caucus (ICPSC). It also participates in information exchange with other economies such as China; Chinese Taipei; and the United States, including the development of an information sharing system regarding product accident reports. The Product Safety Department also provides staff training and other workshops relating to product safety, most recently for Thailand and Viet Nam, and is currently exploring opportunities to engage in greater capacity building in the ASEAN region.

Japan is quite active in providing technical assistance to developing economies in order to build capacity in standards and conformance infrastructure, particularly in Southeast Asia. For instance, JISC is also active in the ISO Training System and has provided technical assistance relating to standards throughout the ASEAN region, including in Indonesia and Viet Nam. Most notably, in conjunction with the Japan International Cooperation Agency (JICA), NMIJ was instrumental in the development of Thailand's National Institute of Metrology (NIMT), particularly in the training of staff.

Benefits to Business and Trade

In general, Japanese businesses understand the benefits of standards compliance and the process for certification is clear with information easily available. The JIS Mark in particular is a useful mechanism to signify quality, especially for SMEs. Many SMEs in Japan may have cutting-edge technologies, but lack the human and monetary resources needed to develop standards. Therefore, JISC has established two new schemes in order to support SMEs' participation in standardisation activities.

- Standards Development Program to Create New Market: In Japan, standards are usually developed through a series of discussions by a related industrial association and include various stakeholders. Under this scheme, the Japanese Standards Association (JSA) will provide an expert (advisor) to support MSMEs in proposing a standard, including the administration to develop the standard (e.g., preparation of the draft standard). In 2016, 16 SMEs applied for this scheme.
- Partnership Framework to Facilitate Standardisation: Many SMEs are located in local areas of Japan with their business supported by various organisations such as local banks, local governments, universities and technology institutes. Under this scheme, some of these organisations are registered as “Standardisation Partner Organisations” in close collaboration with JSA to support MSMEs' business activities relating to standardisation. As of 31 December 2016, there were 114 Standardisation Partner Organisations registered.

All of the respondents interviewed for this case study emphasised the importance of participating in the relevant international organisations and being signatories to the respective mutual recognition agreements in order to support cross-border trade. Since signatories to the ILAC MRA and IAF MLA recognise, for example, testing and calibration reports that are issued by accredited conformity assessment bodies in other economies as being equivalent, it therefore removes the need for additional testing and certification in the importing markets. Additionally, the Japan External Trade Organisation (JETRO) also provides assistance to SMEs in Japan to enter foreign markets.

Although studies that quantify the benefits to Japanese exporters are limited, these agreements are certain to provide significant benefits in terms of time and cost savings. Given the progress that Japan has made in harmonising standards internationally, it is more often domestic regulations that present the greatest challenge to increasing international trade. Box 2 shows how such regulations can impede international trade even if the same standard has been adopted by using an example of personal care robots.

Box 2: Personal Care Robots and Technical Barriers to Trade

Japan is one of the global leaders at the forefront of robotics technology. Given its demographics, there is an emphasis on innovation of products that can be used to assist the elderly. Japan proposed the new standard for "Safety requirements for personal care robots" (ISO 13482), which was issued by ISO in February 2014. This standard covers three types of personal care robots: mobile servant robots, physical assistant robots, and person carrier robots. In April 2016, JISC established new standards in Japan that clarify specific safety requirements by robot type and plans to propose amendments to ISO 13482 to support the wider application of personal care robots around the world.

However, even if the same standard is used between economies, domestic regulations (product categories) can differ, thereby creating non-tariff barriers to trade. In the case of personal care robots, some types might be classified as medical devices in the European Union and are therefore required to be certified by a body that is located in the EU. Although JQA has provided certification in Japan based on ISO 13482 since 2014, it does not currently have an entity located in the EU that can provide such certification. JQA therefore needs to explore a possible bilateral agreement with a certification body based in the EU, but government-to-government coordination will also be necessary. (Similarly, the United States requires FDA certification for medical devices.)

Outlook for Standards and Conformance Infrastructure in Japan

Standards and conformance infrastructure in Japan continues to evolve so as to meet the demands of both the private sector as well as consumers. Conformance to standards is often seen as a way to signal a minimum level of product quality. However, once that minimum level of quality has been achieved, the development of new standards to differentiate product quality can be used to spur innovation among manufacturers. Through the ongoing development of a high-function JIS scheme, JISC aims to further promote and recognise such innovation. Under this scheme, the JIS Mark will receive a grade so as to indicate a higher level of precision and/or performance in the product. For example, JISC is currently developing a high-function JIS for different grades of wrinkle-free fabrics to better indicate the wrinkle resistance performance of the fabric.

The proposed revisions to the Industrial Standardisation Act will also enable Japanese businesses, especially those in the services sector, to better respond to rapidly changing conditions of global competitiveness. For example, the development of standards for logistics services, such as cold chain delivery, could enable greater differentiation for high-quality providers. This is a particularly important standard for Japanese exporters of these services since competition in the region is quite high. JISC is also currently active in the ISO discussions concerning the development of standards for the sharing economy.

Japan continues to prioritise international collaboration in order to create high-quality standards and conformance infrastructure that is designed to react quickly to industry demands and support global trade. For instance, a current KPI for JISC is to raise its level of international engagement by increasing the number of Chairs and Conveners it has in forums relating to international standards. Japan currently has about 200 people in such roles. This emphasis on international cooperation, along with its forthcoming revised standards-setting process that will enable the private sector to enact standards more easily and quickly, will help to ensure that Japan remains a global leader in standards.

PERU

Standards and Quality Infrastructure Agencies in Peru

The National Institute of Quality (*Instituto Nacional de Calidad*, INACAL) is a public standardisation body under the Ministry of Production. INACAL is young as an independent institution and was created in 2014. Prior to that, standardisation functions were subsumed under another government agency, the National Institute for the Defense of Competition and Intellectual Property (*Instituto Nacional de la Defensa de Competencia y la Propiedad Intelectual*, INDECOPI).

At the present time, INACAL is the only agency establishing, implementing, and enforcing standards policies in Peru. INACAL's functions cover all aspects of the quality system. It operates according to its functions through four Directorates: (1) Standardisation, (2) Accreditation, (3) Metrology and (4) Strategic Development.

INACAL's main functions are:

- To manage and oversee the development of Peruvian Technical Standards (NTP, from its acronym in Spanish – *Norma Técnica Peruana*), accreditation and metrology according to the National Quality Policy and the economy's needs;
- To elaborate the proposal of the National Policy for quality, support it to the National Council for Quality (CONACAL), and to promote and monitor its implementation;
- To review and periodically update NTPs;
- To contribute to the development of standards on the international and regional level and to ensure that NTPs are adopted and implemented according to Peru's international commitments, including under the relevant WTO agreements;
- To represent Peru in international *fora* and to take part in international activities in the field of standardisation, metrology and accreditation;
- To disseminate information about the importance of standards as tools, to increase market access and facilitate technology transfer for businesses; and
- To promote a culture of quality, contributing to public and private institutions using the infrastructure of quality.

Currently, all standardisation in Peru is done through INACAL, which is a public body; there are no private standards bodies. Accreditation and metrology are also covered exclusively by INACAL. However, there are other institutions, both public and private, that contribute to Peru's quality infrastructure in a broader sense.

The Ministry of Trade and Tourism (MINCETUR) is responsible for setting trade policy, including the trade-related aspects of standards. It is the contact point for the WTO Agreement on Technical Barriers to Trade, and is responsible for briefing the Peruvian delegates representing Peru's interests in the WTO on the official position regarding Technical Barriers to Trade (TBT) and Sanitary & Phytosanitary (SPS) issues. MINCETUR is also responsible for negotiating all aspects of free trade agreements, including the TBT and SPS chapters and other related issues. In general terms, MINCETUR coordinates with INACAL for high level political decisions related to TBT, which INACAL subsequently implements in its operations. Also, INACAL provides technical support to MINCETUR on TBT agreement in FTA related to standards and conformity assessment procedures. INACAL is the Information Center of TBT for voluntary sector (standards and conformity assessment procedures).

The General Directorate on Environmental Health and Food Safety (*Dirección General de la Salud Ambiental y Inocuidad Alimentaria,* DIGESA) is a governmental body under the Ministry of Health that is responsible for certification and assessment of safety for all manufactured food products except for hydrobiology resources.[33] DIGESA is a contact and inquiry point for the Codex Alimentarius in Peru. DIGESA has 3 Directorates: (1) The Directorate of certifications and authorisations, (2) Fiscal and Sanctions Directorate, and (3) Directorate for Control and Surveillance. It conducts two types of tests in their laboratories: biological and environmental tests. DIGESA is more of a surveillance authority rather than one that promotes exports. Normally, the samples are brought to DIGESA for analysis by inspection bodies. It conducts the analysis based on NTPs and Codex standards. However, DIGESA can also issue documentation related to exportation, stating the results of laboratory tests for a particular product.

The National Authority of Fish Products Safety (*Organismo Nacional de Sanidad Pesquera,* SANIPES) is the main body responsible for the fish industry in Peru, under the Ministry of Production and the Vice-Ministry of Fisheries. Prior to 2014, SANIPES formed a part of the ITP (see below), but now it is an independent agency. Given the fact that fish and fish products are of major export interest for Peru, SANIPES is an important authority for the industry in general, and in terms of S&C in particular. SANIPES has the so-called "designated bodies" at its disposal. These are supporting entities, mainly laboratories, which are designated by SANIPES and accredited by INACAL to conduct microbiological tests. Based on the results of these tests, SANIPES is authorised to issue official export certificates. The export certificates may be in a general format for international trade, or in a format specified by an economy of destination.

The Production Technology Institute (*Instituto Tecnológico de Producción,* ITP) is a public technical assistance body with the purpose of boosting the competitiveness of national producers. The ITP has more than 33 years of history, having originally been created as an agency for fish producers. Prior to 2013, it was called the Technology Institute for Fisheries. Subsequently the areas covered by its services grew and started to include other areas such as agricultural products, wood, and some industrial products, and its name was changed to the ITP. The ITP provides research, innovation and development services to major Peruvian industries, mainly in the form of technical assistance through its Centers for Productive Innovation and Technology Transfer (*Centros de Innovación Productiva y Transferencia Tecnológica,* CITEs).

Currently the ITP has 41 CITEs (25 public and 16 private). Public CITEs cover most of the traditional Peruvian industries, including those of export interest such as CITE *Pesquero* (Fisheries, the oldest and biggest one), CITE *Madera* (Wood) and CITE *Calzado* (Footwear) The rationale for creating private CITEs comes from producers who encounter a need for innovation and technical assistance in a particular sector. They can decide to form a CITE themselves, but with the support and oversight of the ITP. The work is conducted in the following way: normally a producer having an issue or inquiry contacts the ITP and the ITP provides assistance through the relevant CITE by conducting a study, research, or investigation, for both export and national consumption purposes. Then it will provide the producer with the

[33] Certification and assessment of raw and primary food products is covered by the National Service for Agrarian Health *(el Servicio Nacional de Sanidad Agraria,* SENASA)

results of the investigation and recommendations, for example on how to enter a particular international market. Often these recommendations include the importance of conformance with national and international standards.

The Supervisory Agency for Government Procurement (*Organismo Supervisor de las Contratacciones del Estado,* OSCE) is not directly responsible for S&C or standards policy implementation. Currently, there is no legal provision stipulating the mandatory conformance with standards as a pre-requisite to participate in government procurement tenders. However, contractors are free to specify certain requirements in their tender documentation. OSCE representatives indicated that the recent tendency is that more and more contractors are including a requirement that tender participants have their products or management systems officially certified, and often certified not only according to NTPs but also according to international standards, such as ISO. This creates the incentive for companies wishing to participate in government procurement tenders to bring their products and services into conformance with official standards and to certify them. Given the size of the government procurement market, this mechanism has the potential to help promote the uptake of standards by Peruvian businesses, which can then use them more widely.

As was mentioned above, INDECOPI currently is not charged with any responsibilities in the area of standards. However, it is responsible for consumer protection and has a special system of consumer alerts, where consumers can draw INDECOPI's attention to quality issues with a particular product or producer. Currently, most of the claims come from the automobile sector, followed by electronics, and pharmaceuticals. In terms of standards, INDECOPI's role can most likely be described as 'advisory': if a particular product or sector receives a large amount of consumer claims, INDECOPI holds public consultations with the producers of these sectors and advises them to raise the quality of their product or services, often by adopting NTPs or international standards.

As for private bodies, the two main players are INASSA and SGS. INASSA (recently bought by the international company NSF) is the designated agency of SANIPES, and the largest laboratory accredited by INACAL providing services of safety inspection and certification to a wide range of companies in Peru. Mainly, INASSA provides conformity assessment for fish products, agricultural products, and pharmaceuticals, as well as environmental assessment (air, water). Producers wishing to export to a particular economy can contact INASSA, and obtain information on which laboratory tests should be conducted, according to individual product requirements. After conducting all necessary tests, INASSA provides the exporter with an official document containing test results. Depending on the product, the exporter will either use this document as part of its shipment documentation, or would need to apply to the relevant government agency for a particular export certificate. For instance, because INASSA is designated by SANIPES, the results of laboratory tests conducted would automatically be accepted by SANIPES for issuing an export certificate for exporters of fish products.

SGS is a private company with global presence, operating similarly to INASSA, but providing a wider range of services, including consultancy services for exporters, guiding them through all the relevant procedures needed for export to a particular economy, and also providing inspection, analysis, and certification services. SGS supervises 85% of all fish flour exported from Peru, and 75% of oil, gas, and other mineral products. They also provide technical assistance and capacity building services for exporters through SGS Academy.

Standards Policy Setting in Peru

For the purposes of establishing and institutionalising standards in Peru, there are 271 national technical committees and sub-committees; they participate in 47 ISO technical committees and in five Codex technical committees.

.

The main stakeholders involved in the standardisation process are:

- State (ensures a reliable system of quality infrastructure);
- Consumers (potentially obtain safer and better quality products);
- Private sector (businesses obtain competitive advantage when their products or services meet higher quality requirements), including exporters (who potentially obtain access to international markets by having their products standardised and certified); and
- Academic representatives (they provide support for research and laboratories).

The regulatory framework for standard setting in Peru consists of the following main elements:

- Law N° 30224 creating the National Quality System and INACAL;
- Supreme Decree N° 004-2015-PRODUCE approving the organisation of INACAL's functions; and
- Supreme Decree N° 046-2014 on National Quality Policy, the main objective of which is to contribute to improving the competitiveness of goods and services in terms of production and trade, supporting a better quality life for the population, and sustainable development, through guidelines and assembling actions related to development and evidencing quality.

The National Quality Policy establishes four policy priorities and their respective strategic guidelines. These priorities are: (1) Institutional strengthening, (2) Creating and increasing the culture of quality, (3) Development of services related to quality infrastructure, and (4) Facilitation of production and commercialisation of goods and services in terms of quality.

Currently, there are 4,801 standards (NTPs) in Peru covering products and management systems. Most of the standards are elaborated for the manufacturing industry (2310), food and agriculture (1319), electronics and telecommunications (304), and healthcare and medical devices (320). According to INACAL data, 17.8% of medium and large enterprises develop their principal products using NTPs, 30.9% of the same group have conformity certificates for their main products, and 20.7% have used metrology and calibration services for their operations. Geographically, the enterprises requiring calibration services are mainly located around the capital: in Lima and Callao (49%); followed by Arequipa (8%) and La Libertad (7%); and operate in the area of raw materials, production, food and beverage commercialisation, fuel commercialisation, pharmaceuticals, industrial and mining services, textile and agriculture. Of course, take up of standards among MSMEs remains an important issue, in the same way as in most other APEC economies.

The Institutional Operative Plan aims to improve the quality infrastructure and increase the use of standards (also internally referred to as "quality culture" by INACAL) by the following means:

- Developing and approving 800 new and revised NTPs by the end of 2017;

- Strengthening full memberships in international standardisation organisations, and increasing participation in international Technical Committees (TCs) according to the Peruvian economy's needs (the target for the end of 2017 is 59 TCs);
- Increasing capacity to cover demand for NTPs and establishing a reliable mechanism to disseminate information and technical assistance activities to industry in terms of standardisation (the aim is to have 10 meetings/workshops by the end of 2017).

In addition, the Strategic Institutional Plan has the following objectives, *inter alia*, to be met by 2019:

- To have a 5% annual increase in standards use;
- To have 100% of domestic regions covered by Standardisation TCs; and
- To develop 1050 new and revised NTPs annually and to have 50% of the NTPs harmonised with international standards.

Based on the Strategic Standardisation Program, INACAL identifies the need for new standards or the amendment of existing standards. Every three years, formal letters to the public and private sectors are sent out to identify areas for improvement. After that, INACAL holds meetings and workshops with stakeholders to determine the further work to be done.

Moreover, INACAL is running a series of campaigns aimed at general awareness and "quality culture". Examples include creating special electronic quality applications (CALIAPP), TV, radio and digital advertising campaigns, and dissemination of information to consumers about their right to demand evidence of quality when buying products. One of the standards recently adopted is an NTP aligned with ISO 37001 on anti-bribery management system.

Resources Available

Concerning funding, most of the S&C agencies in Peru receive government financial support. The annual budget for INACAL is around 10.5 million USD, and the ITP's annual budget is about USD $55 million USD, to be distributed among 25 CITEs. SANIPES's annual budget is about USD$20 million USD. As for the private institutions, INASSA disposes about USD$700,000 for equipment annually, and has recently invested about USD$4.8 million in acquiring the land to build a new laboratory, and USD$7.7 million to equip it.

Regarding human resources, INACAL has 151 permanent staff members, the ITP employs 380 people, and SANIPES has 170 people as permanent staff. INASSA has about 173 people, including technical experts in pharmacy, microbiology and microchemistry.

As for other facilities, the INACAL Metrology department has 19 measurement and calibration laboratories, the ITP has one laboratory, SGS has nine laboratories at its disposal (three in the fisheries area and six in the area of the mining industry), and INASSA has three laboratories. SANIPES has 13 offices across the economy, four of which are centres offering international trade certification.

Alignment with International Standards, International Engagement and Involvement with MRAs

One of the priorities of INACAL is to align more NTPs with international standards. This priority fits well with APEC's commitment to alignment with international standards. In 2016,

39% of NTPs adopted were aligned with international standards, and the goal for 2017 is to have 47% of this year's NTPs internationally aligned. In establishing NTPs, there are are 271 national technical committees and sub-committees; they participate in 47 ISO technical committees and in five Codex technical committees. Table 5 shows the percentage of NTPs that are aligned with relevant international standards, by major sector.

Table 5: Peru's Alignment with International Standards, by Sector

	ISO	IEC	ITU	Codex
General manufacturing	13.6%	0,7%	0	0
Electronics and telecommunications	30%	66%	0	0
Food and agriculture	2%	0	0	1.6%
Services	63%	0	0	0
Healthcare and medical devices	34%	11.5%	0	0
Extractive industries	6.5%	3.22%	0	0

Source: INACAL data and authors' calculations.

It is worth mentioning that the alignment with international standards has increased significantly in recent years. In 2011, before the creation of INACAL, only between 12% and 15% of NTPs were aligned with international standards, with this number being likely to almost triple by the end of 2017.

INACAL is a full ISO Member and participates in 43 Technical Committees (eight as Observing Member and 35 as Full Participating Member), as well as four PDCs (one as Observing Member and three as Full Participating Member). INACAL also aims to promote international engagement in line with mutual recognition arrangements (MRAs) with IAF, ILAC, APLAC and PAC. INACAL is not a Member of the International Electrotechnical Commission (IEC), but it participates in the Affiliate Country Program and is making efforts to become a full member by the end of 2017. At the regional level, INACAL forms part of the Pan-American Committee on Technical Standards (COPANT), Pacific Area Standards Congress (PASC), and the Andean Community (CAN).

In the area of metrology, INACAL is Associate to the BIPM General Conference, and is a signatory to OIML and APLMF. On the regional level, it is a member of Inter-American Metrology System (SIM). Moreover, the Metrology Directorate has demonstrated quite a high level of calibration services internationally. In some recent comparison studies on metrology efficiency in both North and South American economies, INACAL's metrology has received high appraisal and in some cases has demonstrated the best results for particular calibration and measurement services.

In the area of food safety, Peru is a member of Codex Alimentarius, and as was mentioned above, its national focal point for the Codex is DIGESA. DIGESA holds relevant certifications ISO 17025 and ISO 9001:2008, and has also cooperated with the FAO on several occasions.

SANIPES holds the following international certifications: ISO IEC 17020, ISO IEC 17025, ISO 9001:2008, ISO 27001:2014, and operates its international cooperation programs through conventions and agreements, such as the convention with the Chilean fisheries authority (*Sernapesca*) on exchange of professional experience, conventions with fisheries entities in Bolivia and Ecuador, and the upcoming convention with the Colombian National Food and Drugs Surveillance Institute (INVIMA). SANIPES is also in constant cooperation with the EU's quality infrastructure agencies, which assist SANIPES in assuring the safety and quality

of food products according to European standards. Due to this cooperation, SANIPES export certificates are accepted by the EU counterparts. Another cooperation agreement that was mentioned is the one between the Peruvian government and the World Bank on funding for investigation projects in the field of hydrobiology resources.

One of the major programs of the ITP's international cooperation in the field of standards is the agreement with the Public Institute of Quality of the Republic of Korea in the field of leather and footwear. The ITP also realises its international cooperation through its CITEs, for instance CITE Fisheries has an agreement with the Industrial Investigation Institute of Valencia, Spain.

As for the private quality infrastructure institutions, INASSA holds the following accreditations: ISO 17025 (accredited laboratory), ISO 17020 (accredited inspection body), and ISO 17065 (certification body). INASSA is a signatory to MRAs with ILAC and IAF, and is also a Member of the Grain and Feed Trade Association (GAFTA) and a Superintendent Member of the Federation of Oils, Seeds, and Fats Associations (FOSFA). The major benefit of these agreements, as indicated by INASSA's representative, is the constant presence in the markets of oil and other animal products. Another membership to be mentioned is the one with the American Oil Chemists' Society (AOCS) that includes four evaluations of INASSA's operations per year. Also, INASSA cooperates with foreign standards bodies when INACAL does not have a specific NTP, and thus cannot provide accreditation according to the standard needed. For instance, INASSA cooperated with the ANSI – ASQ National Accreditation Board (ANAB), the US accreditation body, in order to ensure that an exporter's product would be recognised by ANAB when exported to the US. INASSA is also an associate member of the Marine Ingredients Organisation (IFFO) that represents and promotes fishmeal, fish oil, and marine products industries all over the world. Like INASSA, SGS is also a member of IFFO, GAFTA, and FOSFA.

As for other cooperation programs, INACAL participates in the Standards Alliance Program, which is a funding facility for providing capacity-building assistance to developing economies, specifically related to implementation of the WTO Agreement on Technical Barriers to Trade. Mainly, INACAL's Directorate of Standardisation receives support in the area of standards for medical devices and textiles, and possibly also support in the areas of petroleum, diesel, and the oil sector in the future. The benefit of this program is increasing capacity on NTPs, ISO and ASTM standards in the mentioned sectors.

INACAL cooperates with the German Metrology Institute (PTB, for its acronym in German) on a range of regional projects in the area of environmental protection, such as the "Guide to present National Standards on biodiversity products to Draft International Standards", "Strengthening QI for Traceable Measurements of Greenhouse Gases to support their Measurement, Report and Verification" and "Development of accreditation requirements for greenhouse gas validation and verification bodies, GHG inventories certification for quality infrastructure services" among others. At a bilateral level, these entities cooperate in this area through the project"Strengthening National Quality Infrastructure to support natural resources management and monitoring of environmental and climatic parameters".

Benefits for Business and Trade

National standardisation activity and aligning standards with international standards benefits producers on both the domestic and international levels. Domestically, it improves business productivity and efficiency by improving production processes, and encouraging the

application of new technologies, both because technical standards transfer technology to comply with the established standards and to certify the product or service, and thus, contribute to innovation.

On the international level standardisation, MRAs, and the alignment of NTPs with international standards contributes to better global market access for Peruvian exporters. Higher standards encourage competition and better quality products, and allow Peruvian firms to expand their sales abroad, with consequent beneficial effects on employment.

To increase export competitiveness, INACAL has special programs to help exporters, for instance to collaborate with *Promperu* (Peru Export and Tourism Promotion Board) which conducts research on the main products with trade potential, and to focus on these products and work closely with INACAL on relevant standardisation activities. There are different technical committees and sub-committees tailored to specific products of export interest, such as coffee, quinoa, asparagus, nuts, cacao, and others. INACAL also cooperates with ADEX, the Peruvian Exporters Association, to understand the main needs of exporters in the area of standards.

Some success has been noticed in this field, where some agricultural products like quinoa and asparagus made great progress supported by the work done in respective technical committees and sub-committees which helped to increase the quality of the products and their acceptance in international markets. For instance, the national standard for asparagus and Andean community standard for lucuma have been promoted to Codex level, in part due to the efforts of like-minded economies with which the Peruvian authorities have actively engaged to promote this important agenda.

94.3% of Peruvian companies are micro-enterprises, and 4.9% are small enterprises; medium and large enterprises only occupy 0.2% and 0.6% of the market respectively. Taking into account such a high percentage of micro- and small enterprises in the economy, and the scarce resources they usually have at their disposal, one of INACAL's main focuses is to implement programs to increase the awareness and use of standards by MSMEs. For example, INACAL created a special standard NTP 933.961: 2015 "Integral management model of MSMEs". This standard is less stringent than general management systems standards, but it serves as a base and as a first step for MSMEs to develop their management systems and subsequently to be able to apply higher standards as they grow and develop. Also, the Presidency of Peru provides special prizes for MSMEs – and they are making efforts to get extra points by following the standard, which serves as a motivation. INACAL's attention to the special issues confronting MSMEs in relation to S&C is in line with APEC's emphasis on MSMEs in recent years, and the general recognition that MSMEs play an important role in the regional economy, particularly in developing member economies.

INACAL recently has implemented technical assistance programs in four different regions of Peru for industries of major interest, such as agriculture, wood, textiles, and footwear, with the participation of 19 enterprises, 40% of which were successful in implementation of relevant standards and inclusion in value chains (for instance, they became suppliers to bigger companies or were able to participate in government procurement tenders).

The ITP has implemented various programs through its CITEs to help MSMEs implement standards related to processes and productivity improvement in their operations. For instance, CITE *Madera* (Wood) implemented the program for "Improvement of Wood School Furniture Design for MSMEs", CITE *Calzado* (Footwear) implemented the program "Definition of

footwear specifications for the army to be included as technical requirement for public purchases". As a result of this program, footwear technical specifications based on NTPs were revised and a new product standard, NTP-ISO 20347:2008 (Personal Protective Equipment – Occupational Footwear), was proposed.

Currently there are 1291 enterprises in Peru certified with ISO 9001 (quality management system).

Conclusion and Way Forward

S&C infrastructure in Peru has all the major elements in place, and they are performing their functions in a coordinated and effective way. INACAL is the only agency directly responsible for standardization while MINCETUR, DIGESA, and SANIPES promote conformity assessment. SANIPES There is also a range of institutions with primary responsibilities not directly related to S&C, but which are nevertheless involved in maintaining the S&C infrastructure. For instance, OSCE and INDECOPI do not regulate standards, but their activities motivate producers to adopt and implement standards in order to provide better quality products and services, and acquire a competitive advantage. The ITP does not set standards, but advises companies on how to raise the quality of their products, be able to comply with the relevant standards and the benefits this conformance will bring to them.

There exists a form of public consultation mechanism in the process of setting, amending, and implementing standards, involving all the stakeholders and allowing them to express their needs and concerns. Peruvian agencies emphasised the need to continuously improve the relationship with stakeholders to facilitate their greater participation in the development of Peruvian standards. Thus, the currently on-going INACAL's study on 'Determining the Current and Potential Demand of Accreditation Services for Laboratories' emphasised the need to create awareness among Peruvian enterprises and promote the advantages of relying on accredited conformity assessments, especially for those enterprises producing goods and services destined to the international markets.

Special focus is placed on the facilitation of MSMEs' participation in standardisation. MSMEs are highly important for the Peruvian economy, as is the case for most other member economies. Various agencies have put significant efforts to assist MSMEs in their day-to-day operations, and to promote their inclusion to domestic, regional, and global markets. For instance, as mentioned above, INACAL specifically set and adopted certain standards that are specifically adapted to the needs of MSMEs.

A range of public campaigns took place and are planned for the future in order to raise the awareness of consumers and business representatives on the benefits of using national and international standards. Use of standards has created some successful stories of Peruvian exporters having been able to gain market access internationally due to their adoption of international standards (quinoa, lucuma, and asparagus, for example; see above) and consistent maintenance of their market share (fish and fish products).

Peruvian S&C agencies have expressed their intention to continuously improve quality infrastructure by investing in new facilities, transferring new technologies, and education for human resources. S&C agencies demonstrated an understanding of the importance of cooperation between the agencies on the national and international level. They also emphasised the importance of participation in the international *fora,* and one of the priorities of their plans

and strategies is to continue to increase international cooperation and alignment of national standards with international ones.

A challenge facing Peru's quality infrastructure is the need to adapt to sometimes rapidly changing technologies and consumer requirements, both domestically and in export markets. The standardisation system is relatively centralised and focused on the public sector. INACAL has demonstrated dynamism in its relatively short period of independent existence, and the accompanying institutions, private and public alike, have also worked effectively, however, relatively centralised systems run the risk of having greater difficulties adapting to change than relatively decentralised ones. Peru's institutions will need to work carefully with stakeholders to ensure they remain sufficiently flexible and adaptive.

The issue of participation in international S&C bodies also looms large for Peru, as for other developing economies. Peru has enjoyed some important successes in terms of taking part in the development of international standards for some of its distinctive export successes. However, the need to work with other economies is very clear to those working in Peru's S&C bodies, and they stand ready to look for areas of mutual interest with APEC economies, as well as those outside the region. Developing economies working together in international S&C bodies can go part of the way towards ensuring that their voices are adequately heard.

SINGAPORE

Standards and Conformance Policy

Established under the authority of the Ministry of Trade and Industry, SPRING Singapore (https://www.spring.gov.sg/)[34] is the national standards and accreditation body of Singapore. It administers Singapore's national standardisation program and manages the Singapore Accreditation Council (SAC), Singapore's national authority for the independent accreditation of conformity assessment bodies (https://www.sac-accreditation.gov.sg/). The National Metrology Centre (NMC) is the national measurement institute of Singapore managed under A*STAR (https://www.a-star.edu.sg/nmc/).

SPRING Singapore represents Singapore at the policy level in international committees, such as the International Organisation for Standardisation (ISO), International Electrotechnical Commission (IEC); and also in cooperation with international organisations such as the Asia Pacific Economic Cooperation (APEC) and Association of Southeast Asian Nations (ASEAN).[35] Meanwhile, the SAC works with other accreditation bodies to establish and maintain Mutual Recognition Arrangements (MRAs) to facilitate regional and international trade.[36] SPRING works with MTI and other agencies for cross-cutting issues such as WTO notifications.[37]

Standards developed by SPRING are voluntary, but may be made mandatory if adopted by regulators. About 40% of all standards are used by regulators mainly in critical areas regarding safety and health. As one of the main concerns in Singapore is protecting its business-friendly image, regulatory bodies are wary of burdening industries with excessive regulations.

Standards and Conformance Infrastructure (S&C) Agencies

SPRING Singapore

SPRING Singapore has dual duties: (i) helping Singapore enterprises grow and building trust in Singapore products and services; and (ii) acting as the national standards and accreditation body by developing and promoting internationally-recognised standards and quality assurance infrastructure.[38] This is done through strengthening the business ecosystem, supporting restructuring efforts, nurturing innovative and high-potential start-ups, and identifying growth opportunities[39].

In acting as the national standards and accreditation body, SPRING Singapore is responsible for administering the Singapore Standardisation Programme and Singapore Accreditation Programme, formulating the policies, strategies, programmes and procedures of Programmes;

[34] Sources: https://www.spring.gov.sg/About-Us/Pages/spring-singapore.aspx, and http://2016.trade.gov/td/standards/Markets/East%20Asia%20Pacific/Singapore/Singapore.pdf
[35] Based on the interview with SPRING Singapore conducted on 20 July 2017.
[36] Source: https://www.spring.gov.sg/Building-Trust/Accreditation/Pages/singapore-accreditation-council-accreditation-schemes.aspx.
[37] Based on the interview with SPRING Singapore conducted on 20 July 2017.
[38] Source: https://www.spring.gov.sg/About-Us/Pages/spring-singapore.aspx.
[39] SPRING annual report 2015/16.

publishing voluntary[40] Singapore Standards (SS) and Technical References (TRs)[41]; and safeguarding Singapore's interests at the international and regional standards fora.

Thus far, SPRING has been working with more than 1,000 standards partners and some 100 partner organisations through the industry-led Singapore Standards Council (SSC)[42] and Standards Development Organisations to develop and promote standards in Singapore.[43] The SSC is the body which approves the establishment and withdrawal of the SS, sets up Committees and Working Groups to develop new standards and review existing standards, and advises and assists SPRING in implementing the policies, strategies, programs, and procedures of the Singapore Standardisation Programme.

SPRING also oversees product safety regulations, consumer safety, the Weights and Measures programme, as well as fair trading practices. With regards to product safety, Controlled Goods under the 45 categories of household electrical, electronic and gas products must be registered with SPRING and bear the SAFETY Mark before they can be sold in Singapore. SPRING also has the authority to investigate and stop the supply of products (general consumer goods such as toys, children's products, clothing, furniture, sports equipment, DIY tools, and other household items) that do not meet applicable safety standards in line with the Consumer Goods Safety Requirements Regulations (CGSR). The Weights and Measures programme aims to protect consumers and traders by regulating the use of weighing and measuring instruments for trade and pre-packaged goods.

With regards to fair trading practices, under the Consumer Protection Fair Trading Act (CPFTA), SPRING Singapore can look into cases of errant retailers who persist in unfair trading practices. Specifically, it will be able to (i) gather evidence against persistent errant retailers; (ii) file timely injunction applications with the courts; and (iii) enforce compliance with injunction orders issued by the courts.

Singapore Accreditation Council (SAC)

Operating under SPRING Singapore, the SAC was formed in 1996 as the national authority for the independent accreditation of conformity assessment bodies in Singapore. Its primary function is to accredit conformity assessment services, such as testing, calibration, inspection and certification, as well as working with other accreditation bodies to establish and maintain Mutual Recognition Arrangements (MRAs) to facilitate regional and international trade. In essence, the SAC enables customers to trust Singapore and MRA partners' products.[44]

The SAC comprises representatives from industries, purchasers and suppliers, government departments, professional bodies, national standards authority, certification bodies, and

[40] All standards developed by SPRING are voluntary, but they may be adopted by regulators and therefore, made mandatory for the industry.
[41] Technical References (TR) are transition documents developed to help meet urgent industry demand for specifications or requirements on a particular product, process or service in an area where there is an absence of reference standards.
[42] Appointed by SPRING, Singapore Standards Council comprises representatives from the private and public sectors. It aims to strengthen public-private collaboration and encourage stakeholders with diverse interest to participate in standards development.
[43] Source: https://www.spring.gov.sg/Building-Trust/Std/Pages/standards-council-standards-development-organisations.aspx.
[44] Source: https://www.sac-accreditation.gov.sg/about/Pages/Introduction-to-SAC.aspx.

consumer interest groups. The private sector representatives participate extensively in SAC Committees and Technical Committees to provide industry perspectives and considerations when developing strategies and accreditation services.

To-date, the SAC has accredited approximately 350 conformity assessment bodies (CABs)[45]. These CABs are in the following, but not limited to:

- Calibration and testing laboratories covering chemical, biological, environmental, medical, medical imaging, electrical, nondestructive testing, gaming and testing related to civil and mechanical engineering;
- Inspection bodies for areas such as industrial pressure vessels and lifting equipment, motor vehicle, structural steelwork and cargo;
- Quality management system (ISO 9001) certification bodies;
- Environmental management system (ISO 14001) certification bodies;
- Product certification bodies;
- Occupational safety and health management system (OSHMS) certification bodies;
- Hazard Analysis and Critical Control Points (HACCP) food safety management system certification bodies;
- Food safety (ISO 22000) certification bodies; and
- Business continuity management certification bodies.

It should be noted that accreditation in Singapore is voluntary in principle, and firms are free to attain accreditation from SAC or from other foreign accreditors for export purposes or for niche products, depending on their needs.

However, accreditation may become mandatory if adopted by the regulator. SAC maintains a close relationship with regulators, with over 60% of regulated areas using accreditation programs developed by SAC.

SAC is currently looking to support emerging areas like cyber security and software testing. SAC also monitors new standards being published, especially in emerging areas such as the measurement of carbon footprint. Additionally, training is provided to keep assessors updated with current trends.

National Metrology Centre (NMC)[46]

NMC, under A*STAR, is the national measurement institute of Singapore, dedicated to advancing measurement science for an innovative and competitive economy. It conducts research and development (R&D) in the science of measurement to enable innovation for emerging technologies.[47]

NMC establishes and maintains measurement standards at the highest level of accuracy and are recognised worldwide through the Mutual Recognition Arrangement on measurement as being traceable to the International System of Units (SI) under the Metre Convention. NMC is also a

[45] CABs are testing and calibration laboratories, certification bodies as well as inspection bodies that provide conformity assessment services.
[46] Source: https://www.a-star.edu.sg/nmc/About-NMC/About-Us.aspx; and https://www.a-star.edu.sg/nmc/Standards/National-Measurement-System.aspx.
[47] The other national metrology institute is Health Science Authority (HSA) under the Ministry of Health, which is the designated institute for chemical metrology (particularly in food) and human health.

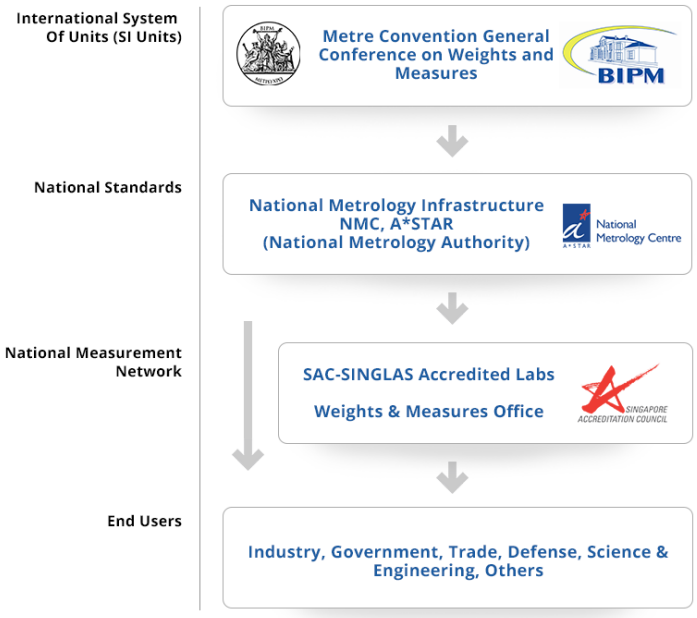
signatory to the Global Mutual Recognition Arrangement on Measurement (CIPM-MRA), coordinated by the International Committee of Weights and Measures (CIPM). The enhanced accuracy of measurements and standards provided by NMC aims to promote fair trade, safe environment, productivity, high quality and reliable products.

NMC actively participates in international comparisons of measurement standards with other national metrology institutes, such as the National Institute of Standards and Technology (NIST, USA), Physikalisch-Technische Bundesanstalt (PTB, Germany), VSL Dutch Metrology Institute (VSL, Netherlands), National Institute of Metrology (NIM, China), Korea Research Institute of Standards and Sciences (KRISS, Korea) and National Metrology Institute of Japan (NMIJ, Japan). This strengthens its role as an interface between national measurement standards and international standards.

NMC additionally works with private companies on research projects, consultancy, training, precision measurements and calibration services. It has ten specialist metrology laboratories, categorised under the electrical, mechanical and optical metrology clusters. It has a private sector representation on its board and it conducts regular dialogues and roundtables with the private sector and government agencies.

The relationship between NMC and the SAC is explained in Figure 17 below.

Figure 17: Relationship between NMC and SAC



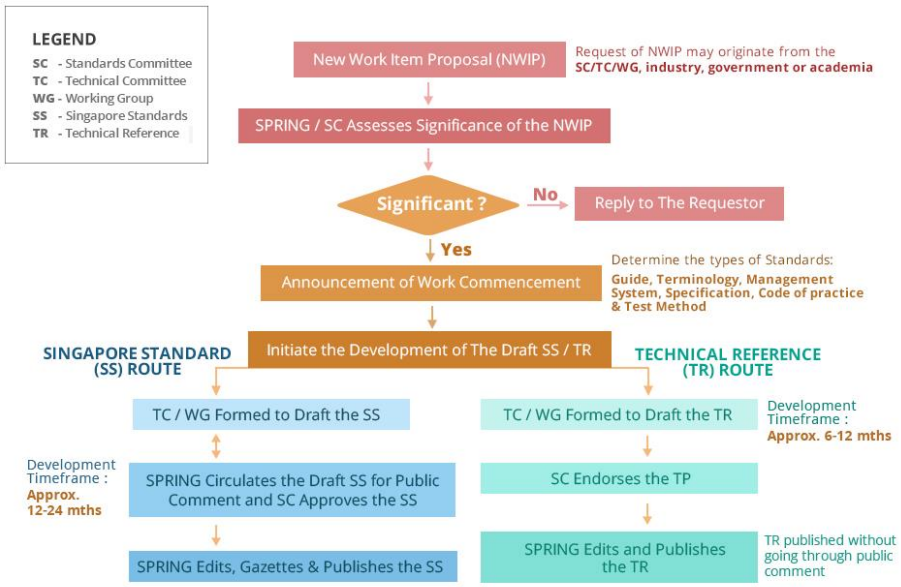
Source: Singapore Accreditation Council

Standards Setting in Singapore[48]

Figure 188 below depicts the standards development process in Singapore.

[48] Source: https://www.spring.gov.sg/Building-Trust/Std/Standards-Development-Process/Pages/standards-development-process.aspx

Figure 18: Standards Development Process



Source: SPRING Singapore

The standards development in Singapore recognises two kinds of approval processes: Singapore Standards and Technical References (TR)[49]. Singapore Standards (SS) undergo a full consensus process, including a two-month long public review before publication. SPRING establishes and publishes Singapore Standards by publication in the Government Gazette.

Unlike Singapore Standards, TRs are not gazetted and are issued without going through the full consensus process; this is to meet urgent market demand. They are pre-standards 'tested' over two years before assessment on their suitability for approval as Singapore Standards. TRs can, therefore, become Singapore Standards after two years, continue as Technical References for further comments, or be withdrawn.

Using Standards in Policy and Regulation

A Singapore Standard can become a mandatory standard when it is referred to by the regulatory bodies in legislations thus making them mandatory for certain products or industries (like in the Singapore Civil Defence Force's Fire Code or in the Ministry of Manpower's Workplace Safety & Health Act).[50] Approximately 40% of Singapore Standards are referenced in regulations and legislations in areas related to safety and health.

Industries in Singapore seldom develop private standards, unlike in larger economies. Most industries are mainly standards takers, adopting international standards as their own when required. Historically, Singapore has relied on MNCs to develop standards; so standards used by the industry usually follow international standards adopted by these MNCs. Nevertheless, in the last 10-15 years there has been a movement towards product ownership in Singapore. In 2014-2016 alone, approximately 360 standards have been developed and reviewed, with an average of around 120 per year.

[49] Source: https://www.spring.gov.sg/Building-Trust/Std/Standards-Development-Process/Pages/types-of-singapore-standards-technical-references.aspx.
[50] Source: https://www.spring.gov.sg/Building-Trust/Std/Standards-Development-Process/Pages/types-of-singapore-standards-technical-references.aspx

Alignment with International Standards, International Engagement and Involvement with MRAs

Singapore encourages the direct use of international standards whenever possible to facilitate trade for companies. National standards are only developed when there are no appropriate international equivalents, or when there is a need to adapt for domestic requirements and conditions. Hence, given the direct use of international standards by relevant parties when feasible, Singapore has only a small stock of 590 national standards.

For example, the Building and Construction Standards Committee of SPRING Singapore recommended that Singapore should align its civil and structural design practice with the Eurocodes. For this purpose, BCA and SPRING have jointly formed Technical Committees comprising representatives from professional organisations, practitioners, academia, and statutory bodies to study the BS EN versions of Eurocodes and review the corresponding UK National Annexes to see if appropriate modifications need to be made.[51]

Regarding MRAs, SAC's MRA partners include various international organisations such as International Laboratory Accreditation Co-operation (ILAC), International Accreditation Forum (IAF), Asia Pacific Laboratory Accreditation Cooperation (APLAC), and Pacific Accreditation Cooperation (PAC). The AB will need to ensure that the Conformity Assessment Bodies (CABs) that they accredit conform to certain international standards, such as ISO/IEC 17025 and ISO 15189 for laboratories, ISO/IEC 17020 for inspection bodies, and ISO/IEC 17065 and ISO/IEC 17021 for accreditation of certification bodies[52].

Additionally, SAC also participates in the OECD Mutual Acceptance of Data (MAD) and the Energy Star Programme recognised by the US Environmental Protection Agency (EPA). Under the MAD framework, GLP studies conducted in Singapore are now recognised in more than 30 OECD member and non-member economies. For the Energy Star Programme, to be recognised by EPA, CBs will need to gain accreditation to ISO/IEC 17065; and the testing laboratory must also first be accredited to ISO/IEC 17025[53].

Benefits for Business and Trade

As a signatory of the World Trade Organisation (WTO) Agreement on Technical Barriers to Trade (TBT Agreement), Singapore needs to ensure that technical regulations, standards, and conformity would not create unnecessary obstacles to trade and to create the predictable trading environment.[54]

SPRING has been encouraging companies, including SMEs, to adopt international standards (such as ISO 22000, a food safety management standard in the food industry) to compete in the global market, maintain the confidence of quality in their product and services and to meet export requirements. In 2015, close to 800 companies were supported in their standards

[51] Source: https://www.corenet.gov.sg/einfo/Uploads/Circulars/CBCA061020.pdf
[52] https://www.sac-accreditation.gov.sg/about/collaboration-international-recognition/pages/mutual%20recognition%20arrangement.aspx
[53] Source: https://www.sac-accreditation.gov.sg/about/collaboration-international-recognition/pages/mutual%20recognition%20arrangement.aspx
[54] Source: https://www.wto.org/english/tratop_e/tbt_e/tbt_e.htm.

adoption. [55] Participation in accreditation programmes that apply internationally recognised standards also provides more credibility for local firms.[56]

As one of the busiest container ports in the world with over 130,000 vessels calling annually, standards also are essential for the Port of Singapore to maintain its capabilities and efficiency. Accredited inspection for bunkering (ISO/IEC 17020) minimises disputes for bunkering operations between the numerous parties, ensuring that port activities operate smoothly.[57]

Additionally, SAC's signatory status in the MRAs provides benefits for enterprises in Singapore by removing the need for duplicative re-testing, re-inspection or re-calibration of goods upon entry to importing economies. For example: the Food and Drug Administration (FDA) of Thailand used to inspect and qualify laboratories in Singapore that are connected to the export of food products to Thailand. However, with the SAC MRA status in APLAC and ILAC, Thai authorities no longer need to inspect labs physically.

SPRING has documented the following benefits of standards[58]:

- The National Library Board's Green Data Centre: to review economic gains achieved as a result of better management of energy consumption and conservation. The case study reported: (1) an estimated more than $55,000 of savings in utility cost per year as a result of conforming to SS 564[59]; (2) An estimated savings of $80,000 per year from the virtualisation of servers, instead of purchasing the necessary hardware.

- NTUC Fairprice ISO pilot study: An ISO pilot study of NTUC Fairprice's procurement; warehousing and distribution; and retail has reported the following benefits of standards. The benefit from the warehousing/distribution function comes from the estimated manpower savings from the implementation of the automated sortation system. Additionally, the impact of all the standards has been to increase consumer confidence resulting in a higher market share of NTUC FairPrice.

Table 6: NTUC Fairprice's Financial Impacts on Business Functions from the Application of Standards

Standards	Affected business functions	Total financial impacts on the BF (in SGD)
Cold Chain Management Standards for Milk & Dairy	Procurement, warehousing and distribution, retail	141,677
Cold Chain Management Standards for Chilled Pork	Procurement, retail	641,639
Carton barcodes, standard pallet	Warehousing and distribution	3,733,151
Total		4,561,467

[55] Spring annual report.
[56] Source: https://www.sac-accreditation.gov.sg/about/collaboration-international-recognition/pages/mutual%20recognition%20arrangement.aspx
[57] Source: '50 Years of Quality & Standards', a publication from SPRING.
[58] Source: https://www.spring.gov.sg/Building-Trust/Std/Pages/benefit-from-standards.aspx
[59] The SS 564 standard aim to energy efficiency in data centre facilities by providing a framework as well as a logical and consistent methodology (source: https://www.imda.gov.sg/industry-development/infrastructure/ict-standards-and-frameworks/green-data-centre-standard).

Source: https://www.spring.gov.sg/Building-Trust/Std/Documents/Benefits-From-Standards/NTUC-Fairprice-ISO-Study.pdf

- Economic Benefits of SS CP 83 (Construction Computer Aided Design (CAD)): The Building and Construction Authority studied the benefits of Computer Aided Design for the construction sector aligned to standard SS CP 83 and reported the following key benefits:
    - Saving in time to generate drawings from other disciplines: $151,367
    - Saving in time to read & review drawings with multi-layer CAD files/drawings & standardised symbols: $138,753
    - Saving in time to colour the drawings: $11,851

Singapore is currently leading in the Aerospace Maintenance Repair and Overhaul (MRO) services globally, accounting for a quarter of the Asia Pacific market share. There are over 100 international companies that carry out a comprehensive range of MRO activities in Singapore, including airframe maintenance, engine overhaul, component repair, structural and avionics systems repair, as well as aircraft modification and conversion[60]. Accredited CABs in Singapore were able to support firms such as Rolls Royce with calibration services, which they required for setting up a base in Singapore. As such, the quality of accredited labs in Singapore contributes towards drawing MNCs to the economy.

Conclusion and Way Forward

As a small and open economy, Singapore's standard policy setting is more inclined to follow existing international standards. Additionally, with relatively large volumes of trade, careful attention has been given to ensure that standards will not act as barriers to trade and put unnecessary burden on traders.

Singapore's strong interest in adopting a business-friendly regulatory approach has resulted in flexibility with regards to standards adoption so that firms are not over-burdened by legislation. As only 40% of standards are referenced in regulations, the rest are provided as "approved codes of practice" for firms to adopt as best practices. Officially legislating standards may create inflexibility: if standards are revised then legislation will also need to be revised as a result. Critical areas such as health and safety are often regulated, but otherwise companies are free to adopt their own best practices. In essence, there is a need to keep business costs low and yet still have meaningful standards in place.

A good relationship with the private sector is also an important factor that needs to be maintained moving forward. Standardisation should be viewed as a multi-stakeholder[61] effort whereby the government, industry, academia and research institutes, and consumer protection bodies (i.e., CASE) together participate in an open and transparent platform for dialogue, operating based on the principle of consensus.

[60] Source: https://www.edb.gov.sg/content/dam/edb/en/industries/Precision%20Engineering/Singapore-Aerospace-Supplier-Guide.pdf

[61] Currently there are around 1600 standards partners; 60% consist of private sector and academia, with the remaining 40% is consisting of public sector.

The long-term strategy of S&C Infrastructure in Singapore has been aligned with the Singapore's RIE2020 Plan[62]; in which the government announced that it would commit S$19 billion to research, innovation and enterprise for the period of 2016-2020. The following sectors have been mentioned to be the focus of RIE2020[63]: Advanced Manufacturing and Engineering (AME), Health and Biomedical Sciences (HBMS), Services and Digital Economy (SDE) and Urban Solutions and Sustainability (USS). NMC provides R&D support for these areas in terms of developing relevant measurement methods.

Furthermore, standards play an important role in supporting Global Value Chain (GVC) participation. Measurements need to be harmonised so that parts produced in different economies will fit at the final assembly stage. Standards are also important for cross-border requirements (safety conformance especially, to prevent multiple testing), and to support SPS (Sanitary and Phytosanitary) requirements.

One key challenge for NMC is to anticipate future development and to prepare for the need of technically skilled people to adapt to new requirements. There is also a need to have more accurate measurements to adapt to new products and to adapt measurements to the local context. For instance, heavy metal content requirement is different in Europe and Asia because of different consumption patterns.

For SPRING, the key challenge is the majority of firms could be unaware of the benefits and costs of standards adoption. Some firms do not even realise that they require standards until they try to access a certain market. Currently, government agencies still play a key role to increase the awareness and interest of industries in standards development and adoption. This is different with the case of Germany whereby industry players are willing to pay to participate in standardisation committees. In Singapore and most other economies the challenge is in stirring interest in firms to be more involved with the standards development and adoption process. However, there is a positive trend towards greater industry participation, due to increasing awareness.

To raise awareness, SPRING uses media such as newspapers and magazines to inform of the benefits of standardisation to the public. Occasionally, seminars are organised to launch new standards that could benefit a wide range of stakeholders (e.g., ISO standards on anti-bribery launched together with CPIB).

Additionally, there is currently a lack of standards for services compared to goods, although services comprise of almost 70% of Singapore's GDP, due to the difficulty of precisely standardising various services. One way to overcome this challenge is to standardise the supporting areas of these service industries. For instance, in the medical field, standardisation would be applicable to supporting areas such as tele-medicine, robotics and wearable technology rather than the actual medical service.

However, there has been an increasing recognition of the importance of standards for services. SPRING is focusing on developing standards for services linked to the goods-producing sector such as logistics and e-commerce. Additionally, they have also been exploring emerging

[62] The Research, Innovation and Enterprise (RIE) 2020 plan is Singapore's sixth roadmap for research and development.
[63] Source: https://www.nrf.gov.sg/Data/PressRelease/Files/201601082039441690-20160108_RIE2020%20Press%20Release%20(Final).pdf

technology such as blockchains and anticipating the effects of an aging population through health care services and the silver industry.

VIET NAM

Standards and Conformance Agencies in Viet Nam

The Directorate for Standards, Metrology and Quality (STAMEQ), which is under the Ministry of Science and Technology (MOST) is the main government agency in Viet Nam tasked to establish policies on standards, including its implementation and enforcement. In particular, STAMEQ's function covers the relevant areas of standardisation, metrology, productivity, and quality management. To carry out its roles and functions, STAMEQ is divided into two departments: (i) the functional/policy department and (ii) the technical and service units. In a nutshell, STAMEQ sets the policies on standards and ensures that Viet Nam's national standards are aligned with international standards.

More specifically, STAMEQ has the following functions:

- Set up the policy/legal documentations, i.e. draft laws on standards and technical regulations;
- Develop decrees to serve as guide in the implementation of the law;
- Conduct annual standard planning; and
- Manage the national technical committee that develops domestic standards.

The agency that directly provides Standards and Conformance (S&C) services to firms is the Quality Certification Center (Quacert). Approximately, there are around 5,000 firms that are Quacert customers. These clients come from both domestic and foreign companies. Quacert focuses on certification, using the ISO 9001 as the most basic and voluntary certification for product management system. [64]

Today, Quacert has established testing standards to test products and issue the corresponding certification. For example, Quacert issues the CE MARK certification - relating to electrical and ICT equipment benchmarking standards (e.g., covers air-conditioning systems, kitchen products, among others.). CE Marking on a product is a manufacturer's declaration that the product complies with the essential requirements of the relevant European health, safety and environmental protection legislation, in practice by many of the so-called product directives.[65]

As mentioned earlier, the basic customer certification is ISO 9001 (basic product management quality system). ISO 9001 certification is voluntary, but it forms a significant portion of Quacert's revenues because this certification is sought after by customers for the value it provides. Customers have given positive feedback that this certificate gives them confidence that the product has passed quality and safety standards.

Demand for product certification is higher than supply. This imbalance reflects the current situation whereby technology is progressing rapidly, introducing new products faster than the issuance of corresponding standards by the government, such that there is a perceived lack of the following:

[64] Quacert's use of ISO 9001 started around 18 years ago.

[65] Product Directives contains the "essential requirements" and/or "performance levels" and "Harmonized Standards" to which the products must conform. Harmonized Standards are the technical specifications (European Standards or Harmonisation Documents) which are established by several European standards agencies (CEN, CENELEC, etc.).

- Technical regulations for new products (especially for medical devises, electrical appliances, and internet-related equipment); and
- Technical experts and engineers to establish and certify standards for the new products.

Standards Policy Setting in Viet Nam

In summary, the following are the key steps comprising the establishment and institutionalisation of standards in Viet Nam:

- On an annual basis, STAMEQ conducts a standards planning meeting which involves representatives from the government, the private sector, and concerned industries. This planning meeting serves as a venue for public-private dialogue on national standards.
- During the planning stage, standards submitted by line ministries are reviewed to reduce any unnecessary regulatory overlaps that could burden enterprises.
- Standards that are agreed upon are open for public comments for a period of 60 days. Then, the government, through STAMEQ, submits the agreed standards to the Minister of MOST for approval.
- Once approved, these standards are adopted as national standards. It should be noted that standards are voluntary, but once these same standards are converted to technical regulations, further strengthened by the creation of laws and decrees, the compliance to such standards becomes compulsory.
- Based on Viet Nam's law, line ministers are tasked to develop national technical regulations and to check and monitor compliance to national standards.
- To monitor compliance and measure the level of implementation, a survey is conducted every three years. The said survey is conducted in cooperation with line ministers to find out if standards are implemented and/or if there is a need to revise or upgrade certain standards. For their part, the appropriate industries may submit a letter to line ministers which contain their comments and recommendations on standards that affect their businesses.

As of date, there are over 9,500 national standards in Viet Nam, covering products and systems standards; around 47% of these national standards are harmonised or aligned with international standards. The Prime Minister's Decision No. 712/QD-TTg of 21 May 2010 set the national program on the improvement of productivity and quality of products and goods of Vietnamese enterprises until 2020. Additionally, the Prime Minister's Decision No. 1041/QD-TTg of 1 July 2011 provides the specific details on and application of standards and technical regulations. The following are the key strategic goals of the Decrees for 2016-2020:

- 2000 new Viet Nam National Standards (Tiêu Chuẩn Việt Nam or TCVN) will be developed for key products and goods of the national economy, of which 90 percent are targeted to be aligned with international standards;
- 5000 enterprises will be guided in applying TCVNs and Viet Nam's National Technical Regulations (or QCVN);[66]
- to expand the network of conformity assessment organisations that conform to international standards and are accredited by EU, APEC and other accredited bodies across the globe;

[66] The full meaning of the abbreviation "QCVN" is in Vietnamese language, but essentially, QCVN refers to Viet Nam's quality standards.

- to reach world class status for all laboratories that test the quality of key products and goods;
- to conclude and implement agreements on mutual recognition of conformity assessment results with foreign economies, giving priority to exported or imported products and goods;
- to provide training in standards, technical regulations, and quality control of products and goods in universities, colleges, vocational training schools, and other institutions related to science and technology.

Resources Available

Concerning funding, most of the S&C agencies in Viet Nam receive funding support from the government; except for Quacert, which relies heavily on service fees from customers for its daily operations.

Decision 712 also includes provision on implementing a project aimed to help support VN enterprises' adoption of certain standards such as ISO 9001, ISO 14001, ISO 22000 and ISO 50001. Around 50% of funding support to Viet Nam enterprises in their application for ISO management system comes from government funding.

Alignment with International Standards, International Engagement and Involvement with MRAs

In aligning their domestic standards with international standards, Viet Nam follows the ISO guidance, which serves as a signal for adoption/alignment of national standards with international standards. Moreover, Viet Nam harmonises its standards in line with mutual recognition arrangements (MRAs), notably the ASEAN MRA. Industries are usually encouraged to harmonise with counterpart economies where Viet Nam will export their products.

In establishing the TCVN, there are about 120 technical committees (TCs) involved with 54 sub-committees. About 70 of these TCs are equivalent to ISO technical committees. This kind of structure for TCs facilitates easier interaction with ISO bodies.

Viet Nam participates as P-member (Official participation-member) of 16 ISO technical committees and sub-committees; O-member (Observer member) of about 70 ISO technical committees and sub-committees; and member of 4 technical committees of IEC. In addition, Viet Nam also participates actively in the development of more than 100 ISO and IEC standards by providing comments and recommendations to appropriate international bodies. Active participation is essential to advance domestic concerns regarding the certification process of international/regional standards and also to facilitate clearer understanding of new editions of international or regional standards, thus making it easier and faster to implement these new standards (McCarty 2000).

In the area of metrology, the Vietnam Metrology Institute (VMI)[67] participates in international organisations, and is a full member of the Asia Pacific Metrology Program (APMP) since 1992; a member of the APLMF since 1995; a member of the OIML since 2003; and a member of the ACCSQ since 2000. The VMI is also an associate member of CCPM, and a coalition member

[67] The VMI, although under STAMEQ, remains independent. Its role vis-à-vis STAMEQ is to provide advice to STAMEQ in the area concerning the development of legal, scientific and industrial metrology.

under CIPM-MRA. The Quality Management System (QMS) of VMI for the calibration and measurement services is based on ISO/IEC 17025. There are 12 laboratories at VMI, where 11 laboratories have been accredited in accordance with ISO/IEC 17025:2005 by the Vietnam Laboratory Accreditation Scheme (VILAS). [68]

Viet Nam's Bureau of Accreditation (BoA) is a member of international organisations; a signatory to the International Laboratory Accreditation Cooperation (ILAC) and the Asia-Pacific Laboratory Accreditation Cooperation (APLAC); and also the Pacific Accreditation Cooperation (PAC) for QMS and Environmental Management Systems (EMS) global accreditation. The BoA also accredit outside of Viet Nam. In fact, the BoA has two laboratories in Laos, three laboratories in Cambodia, one inspection body in Indonesia, and one inspection body in Brunei (under the ASEAN framework). Foreign economies are welcome to accredit Viet Nam's Conformity Assessment Boards (CABs); however, an accreditation body is not yet in place in other ASEAN economies. Also, there are restrictions, for example, Thailand and Indonesia do not allow their accreditation bodies to issue accreditation outside of their own economies.

The BoA also manages the Vietnam Laboratory Accreditation Scheme (VILAS). Latest data suggest that over 900 laboratories have been accredited.[69] The BoA accredit the laboratories based on ISO IC-17025; although some ministries recognise laboratories based on their own technical criteria.

Specifically, Viet Nam is involved in the following MRAs: ASEAN, EEMRA and GMP. Under the ASEAN EE MRA program, Viet Nam has adopted more than 100/119 ISO standards. Currently, Viet Nam is looking at another MRA on harmonisation of standards but it is still under negotiation with regard to the certification method and the scale of MRA, especially the coverage of export products as some members want to expand outside the ASEAN region. The Economic Research Institute for ASEAN and East Asia (ERIA) in their 2015 study notes the progress of Viet Nam in the adoption of specific standards in ASEAN in the table below. In addition to MRAs, Viet Nam has also established MOUs with Belarus, Russia, Laos PDR, United Kingdom Accreditation Service (UKAS) and South Korea. Businesses welcome Viet Nam's active participation in MRAs since the certification process within ASEAN region becomes less costly for enterprises engaged in exporting products (via application with Quacert).

Table 7: Viet Nam's Adoption of EEE, Medical Device and Rubber-Based Product Standards in ASEAN

	Identical	Direct Use
Adoption of Harmonised EEE Standards	81	41
Adoption of Medical Device Standards	14	-
Adoption of Rubber-Based Product Standards	6	-

Source: ERIA (2015)

Benefits for Business and Trade

In general, MRAs are beneficial to international trade, since they allow and facilitate the acceptance of testing and certification of products for trading partners.

[68] Source: http://vmi.gov.vn/en/general-introduction/
[69] Source: http://www.boa.gov.vn/en/vilas-introducation

The role of metrology in trade is also important, particularly in introducing a more accurate and consistent metrology system, allowing for a level playing field for trade partners; while also protecting customers and markets, and reducing risks arising from trade. The VMI is also working towards harmonising its metrology instruments with other economies to ensure uniformity and consistency in measurements. Additionally, the VMI is also looking at digitalisation as one way to improve the national metrology system.

Good accreditation in accordance with international standards improves the reputation of enterprises and increases confidence in their products, both in the local and global settings. Accreditation also strengthens the competitiveness of Viet Nam's products in the regional and international markets. One recent example is where conformity with Korean standards via IEC international standards has enabled an enterprise to start exporting LED products to Korea. The LED market in Southeast Asia is a USD 5 billion industry in 2015 and is estimated to reach USD 9 billion in 2016.[70]

It should also be noted that certification and other types of conformity assessment processes are only initial steps. Certification alone may not improve the quality of the products unless enterprises purposely pursue and ingrain quality through an effective and efficient manufacturing process.[71]

The most common feedback received by the BoA is on the length of the process from application to issuance of certificates. Normally, the whole process takes two months. However, there are cases where it takes only 2-3 weeks for the issuance of certification. The BoA is looking at ways to shorten the said process. It is worthwhile to note that the benefits do outweigh the costs since after receiving accreditation certificates, enterprises reported that they have more clients, especially obtaining foreign projects and bigger contracts, because normally, these clients require the certificate of accreditation for establishing business engagements.

Conclusion and Way Forward

In general, the S&C infrastructure in Viet Nam is performing well. There exists a form of public consultation mechanism in the process of setting standards, accommodating inputs and feedbacks from the public and enterprises. There are also efforts to reduce duplication of similar standards that could unnecessarily burden the business sector.

The quality of accreditation is also acceptable, as the accreditation agency in Viet Nam is also a member of several international accreditation bodies and has been trusted to perform accreditation services outside of Viet Nam. Viet Nam is also active in the membership of technical committees in ISO bodies.

At the metrology level, the QMS applied by the VMI satisfies the requirements of the International Committee for Weights and Measures (CIPM) for recognition of national measurement standards and has been accredited by Viet Nam's BoA.[72]

There is a need to continuously improve the relationship with stakeholders to facilitate greater participation in the development of Vietnamese standards. Participation from enterprises, industries, organisations, customers, and experts in technical committees and in the

[70] Source: http://ledtecasia.com/english/customer/customer2?page=view&id=335&ckattempt=1
[71] Source: http://gsi.nist.gov/global/index.cfm/L1-5/L2-45/A-204
[72] Source: http://vmi.gov.vn/en/quality-management-system/

development of ISO, IEC and other standards would improve the quality of Viet Nam's national standards. Towards this, greater transparency and awareness of the standards development process is needed. Improving awareness could be achieved by further disseminating to the concerned public the existence of standards and the benefits of applying those standards. Government agencies should continue providing support to enterprises in their application for ISO 9000 and ISO 14000 in the form of training, consultancy, and certification. This is particularly helpful as most enterprises in Viet Nam tend to be micro, small, and medium-sized enterprises. In this regard, the leadership provided by the Government is still required and important (ERIA 2015).

Optimising the use of internet technology to disseminate existing standards and to encourage feedbacks should be further developed. This is particularly crucial in light of the current situation wherein foreign stakeholders such as importers have signified a lack of understanding of Viet Nam's domestic standards process. Currently, the BoA posts in their website the list of accredited CABs, the assessment fees, and the technical regulations in place. This kind of practice should be continued, with a view of further enhancing the dissemination process to avoid confusion and unnecessary delays.

Viet Nam's agencies that are involved in the S&C process have also expressed the intention to upgrade infrastructures to cope with the rising demand. This infrastructure would include the upgrading of internet equipment, the introduction of cloud computing, and the use of big data analytics so that the implementation and compliance to standards could be effectively and comprehensively monitored onsite and not just at the borders.

In terms of human resources, the current education system in Viet Nam is generally able to meet the staff requirements of BoA and STAMEQ, with hired staff usually coming from technical universities. The BoA also invites technical assessors from accredited CAB; currently, there are over 400 technical experts/assessors hired by BoA. Nevertheless, specific jobs such as technical experts, auditors and specialists require longer on-the-job training of at least 3 years up to 7 years.

Further collaboration in conducting research with universities or science and other research institutions should be further encouraged. In the US, for example, the strong capacity for certification is supported through research activities conducted by the National Institute of Standards and Technology (NIST). This research-oriented approach should be beneficial in the medium and long-term periods as it would help Viet Nam identify ways of improving the policy process, procedures, implementation, and enforcement of standards.

SYNTHESIS OF THE CASE STUDIES

The six case studies were conducted to provide a deeper understanding of the survey responses and to attain more details on the current S&C infrastructure in the various economies. While the lessons learnt from each study could be very much affected by domestic economic conditions and development, there were some similarities among them.

Benefits of Standards to International Businesses

All economies acknowledged benefits to businesses from having standards in terms of increasing and making cross-border trade easier. Australia, Japan and Singapore highlighted the costs associated with duplication and hence the need to remove unnecessary duplicative testing and certification. This, in turn, allows domestic firms to gain access to international markets, and increase their participation in global value chains. Developing economies in particular benefit from accreditation as it strengthens the competitiveness of domestic products in regional and international markets, and facilitates imports and exports with international firms through common requirements. For example, Peru identified the benefits of standards for its local businesses through improved productivity and efficiency which rose from improving production processes and encouraging innovative activities. Adopting international standards increased access to global markets for its local businesses and encouraged competitive behaviour and better product quality.

Benefits of standards could be further strengthened through private sector participation in standards development. Most economies place emphasis on the participation of the private sectors. This usually takes the form of private sector suggesting amendments during the development process or identifying gaps and problems after the implementation of standards, thus enabling development bodies to better understand the needs of the industry. Private sector participation will remain and important ingredient for a sound S&C infrastructure in the region.

International Engagement

All six case study economies have some form of international engagement with regards to standards development or adoption. They emphasised the need to look for best practices when developing standards and adopting international standards whenever possible. Furthermore, there is no substantial gap between industrialised and developing economies when it comes to their take on adopting international standards. For example, in Australia, 95% of proposals to adopt international standards were approved and Viet Nam's key strategic goals for 2016-2020 aims to align 90% of their national standards to international ones.

International engagement appears to be a tool for economies to guide their own domestic processes through information exchange with members of international organisations such as ISO and IEC. Some economies also prioritise such engagements to remain up to date with advances in international or regional standards development, enabling their private sectors to react quickly to changes.

Additionally, developed economies such as Japan have provided technical assistance to developing economies to build capacity in standards and conformance infrastructure.

Challenges Faced

One of the main challenges faced by many economies is anticipating the future direction of standardisation in the face of ongoing product developments. For instance, cybersecurity and software testing is an emerging area that both the industry and governments are looking into. Indeed, this is in line with the survey results where 77% of economies reported having a process in place to develop national standards based on future needs.

Most economies also encourage strengthening innovation and private sector participation. Some of the developing economies, while encouraging greater awareness and participation, are also attempting to address the need to upgrade S&C infrastructure.

Economies have placed emphasis on more high-level innovation when developing standards. For example, Australia focused on block-chain technology in which it gained a first-mover advantage; Japan looked into establishing standards for personal care robots; and Singapore considered standards in emerging areas like cybersecurity, software testing and measuring carbon footprint. These economies also acknowledged the lack of standards in the services sector. While innovation remains a challenge for China, it has, however, been able to foster research in novel areas such as measuring the contribution of accreditation and testing to GDP. Developing economies like Peru, on the other hand, have carried out research and developmental activities in relatively traditional areas of product safety, such as wood for school furniture and footwear for the army.

In addition, the lack of funds or knowledge about standards among small businesses is seen as an important challenge to economies like Japan, Peru and Singapore which aim to increase the uptake of standards among MSMEs.

Furthermore, economies such as Australia, China and Singapore have noted an increase in demand for standards. This consequently places pressure on existing S&C resources especially in terms of finances and manpower. The increasingly technical requirements of standards development in areas like cybersecurity and other internet technology additionally require more skilled manpower, which may potentially be an issue for developing APEC economies due to limited resources available.

Concluding Remarks

As an overall picture, the case studies concluded that business uptake of S&C varied across firms and economies. Nevertheless, interviewees from all economies agreed that there was a strong rationale to increase standards adoption, particularly for firms entering GVCs as they depended heavily on standardised goods and services. Economies have provided several examples of improving business uptake of S&C: Australian government invested in Industry Growth Centres, which mirror national development priorities, to respond to current business trends; China's SAC have conducted outreach programmes such as Standards Day; Japan's JISC have developed two new schemes (i.e. Standards Development Program to Create New Market and Partnership Framework to Facilitate Standardisation) to support SMEs' participation in standardisation activities. Many also note the need to remain innovative and plan for future developments, especially in the areas of services, cybersecurity and other internet technology.

7. CONCLUSION AND WAY FORWARD

This report has summarised information collected during the S&C Indicators project, focusing on findings from the survey of member economies, and case studies of six economies. Its key finding is that S&C infrastructure is well developed across the region, but with substantial differences across key parameters, such as the degree of public and private sector involvement, and sources of funding for S&C bodies. Despite this diversity of experiences, APEC economies are convinced that S&C remains important not only for the economic benefits it brings, but also as a means of ensuring consumer health and safety.

Initially, this project envisaged the possibility of combining quantitative indicators from the survey with publicly available information to produce a quantitative summary of performance. Now that survey results are to hand, a number of issues arise in relation to this approach.

First, although member economies provided substantial inputs on the survey, they were not always in a position to provide data on all points, and sometimes provided data that are not strictly comparable across economies due to differences in structures and practices. This issue could be potentially addressed in subsequent surveys, now that initial information on practices is available. In the future, it may be possible to refine the dashboard design to take this issue into account. At the present time, the focus should be on producing a baseline that can be refined by subsequent work. Second, the survey includes a wide range of qualitative information, such as indications of the relative importance of particular benefits and resources associated with S&C by economy, which cannot easily be included in a quantitative summary. Third, not all of the data points measured have an unambiguous interpretation. For instance, an indicator that summarises the extent to which the key elements of S&C infrastructure exist across economies is unambiguous: a higher score is better. However, an indicator summarising the extent of public or private sector involvement, or sources of funding, would not necessarily mean the same thing to all economies. Although there is a general trend towards more private sector involvement in S&C, it is not clear that economies with primarily public systems would see more private sector involvement as unambiguously "better".

In an effort to provide member economies with a simple, quantitative summary that can be refined in future work, we have adopted a dashboard approach. The purpose of the dashboard is to provide an "at a glance" summary of the state of S&C infrastructure around the region. It draws exclusively on information that is directly quantifiable and comparable across economies. For that reason, for example, it includes indicators of the existence of key S&C institutions, but does not purport to measure quality—for that to be feasible, member economies would first need to develop a consensus on what constitutes best practice, and there would need to be a specific mandate to compare performances across economies. For instances of regional practice that can inform the continuing development and improvement of S&C structures and bodies, we refer member economies to the case studies in Section 5 of this report.

We emphasise that the dashboard does not cover all aspects of the PSU questionnaire. It focuses on information with a straightforward and unambiguous interpretation, and data that are easily quantified and aggregate across economies by averaging. For more detailed results, we refer member economies to Section 4, which presents the survey results in as much detail as possible. The dashboard is designed to be a simple baseline summary only, and we expect that it will be refined and extended in the future.

At the present time, the dashboard covers the following dimensions of S&C performance:

- **Indicators of the existence and the key elements of S&C infrastructure in economies.** The existence of metrology institute, standards agency, accreditation body, certification body and testing laboratory are necessary to ensure that the standards and conformance systems work in maintaining quality and ensuring confidence, efficiency, and accountability in the system.
- **Indicators of economies' participation in international and regional S&C bodies.** Active participation in technical committees is necessary for economies to facilitate better knowledge[73] sharing and exchange, making sure that domestic concerns are being heard. Faster adoption of international standards is also more likely to occur with better international engagement.
- **Percentage of economies' national standards that are aligned with international standards, by major sector.** Alignment with international standards will facilitate international trade and reduce S&C costs (i.e. coming from duplicative testing and certification requirements) for business. Sectoral decomposition will allow economies to focus attention on specific gaps across different industries.
- **Percentage of economies that report having a system to track consumer and business awareness as well as confidence in S&C.** The survey highlighted that the main benefits of S&C lie in the areas of public safety and health, but only 23% of economies report maintain data on consumer awareness and confidence to use certified products and accredited services. Another key challenge for S&C bodies around the region is the uptake of standards by the private sector; particularly in developing economies, where many businesses are MSMEs and may not be able to obtain financing to cover adaptation costs associated with compliance.
- **Percentage of economies that have a process to develop standards based on future needs.** Anticipating future developments in the area of standards is challenging as it requires strong research capacity and good collaboration with the private sector.
- **Percentage of economies that engage in outreach programs in relation to S&C.** APEC S&C bodies recognise the importance of outreach: over 90% of economies for which data are available report that they engage in outreach programs to communicate the importance of S&C.

Each of these indicators has a straightforward interpretation in terms of the objectives of APEC's S&C work. They can be tracked over time, thereby facilitating regular reporting to SCSC on the region's progress in developing S&C infrastructure. However, they are not reductive in terms of the important differences that exist across member economies.

Table 8 below presents results, and summarises the available quantitative indicators on APEC S&C infrastructure and performance. In general terms, the region is a strong performer in S&C, although results are based on partial information, as not all economies provided the necessary information. The basic infrastructure is in place in the region, although the implementation of processes varies considerably across economies. We also emphasise that a 100% score for the existence of S&C bodies across the region does not say anything about quality or effectiveness: member economies need to work constantly to improve structures and processes, including by learning from regional practice, as summarised in the case studies in Section 5 of this report.

[73] ISO highlights that "Standards codify the latest technology and facilitate its transfer. Standards are therefore an invaluable source of knowledge." (Source: http://www.iso.org/sites/ConsumersStandards/1_standards.html)

Table 8: APEC Dashboard of S&C Indicators

Focus Area 1: Systems and Institutions		
S&C Infrastructure		Number of Reporting APEC Economies
• Metrology Institutions	100%	14
• Accreditation Bodies	100%	14
• Testing Laboratories	100%	14
• Certification Bodies	100%	14
• Standard Bodies	100%	14
Focus Area 2: Participation and Alignment with International S&C Systems		
Participation in International and Regional S&C Bodies		
• ISO	95%	21
• ISO P Memberships	262	21
• IEC	76%	21
• IEC P Memberships	73	21
• Codex	90%	21
• BIPM	67%	21
• OIML	86%	21
• IAF	90%	21
• ILAC	95%	21
• APLAC	95%	21
• APLMF	100%	21
• APMP	76%	21
• PAC	90%	21
• PASC	86%	21
Signature of MRAs and MLAs		
• APLAC	86%	21
• IAF	86%	21
• ILAC	95%	21
• PAC	71%	21
• IAAC	24%	21
• APEC EE MRA	86%	21
• CIPM	90%	21
• OIML Basic	38%	21
• OIML MAA	43%	21
Alignment with International Standards	53%	12
Focus Area 3: Business uptake and awareness		
Maintenance of Data on Consumer and Business Awareness	23%	13
Process to Develop Standards Based on Future Needs	77%	13
Engagement in Outreach Programs on S&C	92%	13

Source: Refer to Annex I and II; and Table 4.

APEC economies are active in international and regional S&C bodies, although the level of involvement is typically much higher for developed than developing economies. There is scope for economies to work together to bring issues of common concern to the attention of

international and regional bodies, using APEC fora as a point of contact and exchange to facilitate contacts among domestic bodies, and provide focus to international action.

On the key indicator of alignment with international standards, the level is strong, all the more so since the figure understates the true level of alignment, because some economies provide for the direct use of international standards when there is no relevant domestic standard—such measures are not included in this count, but are significantly trade facilitating, and represent good practice, particularly for small economies.

The main area where economies need to provide increased focus in the future is engagement with stakeholders, and more specifically, measurement of that engagement. Involvement of business and consumer groups is key to effective S&C performance, so it is incumbent upon agencies to develop effective performance metrics so that programs can be data driven and evidence-based. The case studies show that business uptake of S&C varies widely across economies and firms, and there is generally a strong rationale for increasing it, particularly in the context of GVCs that rely heavily on standardised inputs of goods and services. As such, maintaining data on business and consumer awareness is a key first step in putting in place a virtuous cycle of information gathering, diagnosis, and performance upgrading in S&C across the region.

As the current state of the Dashboard shows, a key element of moving forward on the S&C agenda in APEC is data collection. Experience with the survey instrument used for this project suggests that member economies adopt diverging approaches to which data they track, and how they record the information; in a number of cases, for example, we received responses from member economies, but obvious differences in interpretation meant that it was not possible to produce a region-wide summary at the moment. A key recommendation of the report is therefore that member economies, through SCSC, make a concerted effort to develop a common core of data elements that they agree are important for tracking S&C performance. As data collection proceeds, the Dashboard produced here can be complemented and extended.

What elements do we see as particularly important for data collection efforts over the medium term? First, we would recommend that economies work together on the basis of the 2017 MSME Guide to develop a set of quantitative indicators that are specific to MSMEs. Doing so is consistent with the economic importance of this segment within APEC economies, and would complement the contents of the Guide, which is primarily qualitative. Many of the areas identified are susceptible to quantitative measurement, so developing a detailed framework would help advance work on S&C in a way that is fully consistent with work going on elsewhere within APEC.

In addition to this area, we have identified the following types of data points that could be further collected (e.g., through representative surveys):

- Number of firms with ISO quality/IEC[74] certification per 100,000 firms.

[74] APEC PSU had conducted a study for SCSC on the alignment of technical regulations and standards of APEC economies with standards developed by the International Electrotechnical Commission (IEC) in 2011. The study found that APEC member economies are increasingly aligning their technical regulations and domestic standards with international standards, particularly for electrical and electronic products, thereby reducing the likelihood of their constituting technical barriers to trade in the region. Manufacturers therefore have greater certainty in standards compliance, allowing for the realisation of economies of scale in production, while exporters have reduced transaction costs in the form of reduced compliance costs.

- Estimated price premium (in percentage) that can be charged if a product is certified (where that is optional and not mandatory for safety reasons).
- New national standards and accreditation programme that have been introduced in the last year, broken down by sector.
- Average time taken to develop a new national standard.
- Number of MSMEs involved in SDOs and standards outreach to SMEs.

A few related secondary data sources are available as a starting point related to the above list. ISO conducts a yearly survey that shows the number of valid certificates to certain ISO management standards (such as ISO 9001 and ISO 14001) reported for each economy, each year. BIPM collects data on the number of Calibration and Measurement Capability (CMC) available to customers. CMCs could be useful indicators in measuring the metrological performance of National Metrology Institutions (NMIs)[75]. BIPM also collects data on the number of labs participating in Key Comparisons[76] (KC) and Supplementary Comparisons (SC). Participation in a CIPM key and supplementary comparison indicates the technical competence and experience of laboratories and reflects collaboration efforts. ILAC (http://ilac.org/signatory-search/) provides a link for "accredited facilities" for each accreditation body.

This list is presented as indicative only, for consideration by SCSC. Collection of some of these data would require collaboration across government departments, for instance with statistics agencies, but we believe these simple measures would help provide a more comprehensive and comparable quantitative picture of S&C systems across the region. There may be a case for building capacity in the area of data gathering and performance tracking in developing economies, where APEC would also be well placed to facilitate information exchange and dissemination of best practice.

Additionally, case study interviews indicate that an important benefit of standards is consumer protection and safety. However, these interviews also show that there is little or no systematic data collection regarding the impacts of standards at the consumer side. There are no data to answer questions such as:

- What is the level of awareness or acceptance of standards and certifications/labelling among consumers?
- What are the impacts of the S&C infrastructure on consumer protection and safety? (more on the qualitative side)

These consumer-side information can be gathered through representative surveys in markets and among consumers. They can complement the data being collected on the institutional side (e.g., regulators, manufacturers) and inform policies on strengthening standards and conformance infrastructure with a view of ensuring consumer protection and safety.

[75] CMC capabilities depends on competence in measurement science and the economy's need for traceable calibration. Higher number of CMCs may reflect greater development and reliability of the national metrology infrastructures. (Harmes-Liedtke and Di Matteo, 2011)

[76] A larger number of comparisons indicate a higher degree of interaction with other members of the international quality infrastructure and possibly better metrological capabilities that could be acquired or spread. (Harmes-Liedtke and Di Matteo, 2011)

REFERENCES

APEC (1998). Mutual Recognition Arrangement for Conformity Assessment of Telecommunications Equipment.

APEC (2017). Guide to Support Quality Infrastructure Incorporation into MSMEs, Sub-Committee on Standards and Conformance.

Czubala, W., B. Shepherd, and J. Wilson (2009). "Help or Hindrance? The Impact of Harmonised Standards on African Exports." Journal of African Economies, 18(5): 711-744.

Gonçalves, J., and J. Peuckert (2011). Measuring the Impacts of Quality Infrastructure: Impact Theory, Empirics and Study Design, Physikalisch-Technische Bundesanstalt.

Harmes-Liedtke, Ulrich and Juan José Oteiza Di Matteo (2011). Measurement of Quality Infrastructure. PTB Discussion Paper 5/2011.

Hufbauer, G. C., B. Kotschwar, and J. Wilson (2001). Trade Policy, Standards, and Development in Central America. Policy Research Working Paper No. 2576. Washington, D.C.: World Bank.

ITC (2011). The Interplay of Public and Private Standards: Literature Review Series on the Impacts of Private Standards – Part III.

Maur, J.-C., and B. Shepherd (2011). "Product Standards in Preferential Trade Agreements" in J.-C. Maur and J.-P. Chauffour (eds.), Preferential Trade Agreements and Development: Issues and Implications, Washington, D.C.: World Bank.

Racine, Jean-Louis Charles; Tippmann, Christina. 2013. The national quality infrastructure: tool for competitiveness, trade, and social well-being. Innovation, technology, and entrepreneurship global practice brief. Washington, DC: World Bank Group. http://documents.worldbank.org/curated/en/898381468326365704/The-national-quality-infrastructure-tool-for-competitiveness-trade-and-social-well-being

Sanetra, C., and R. Marban (2007). The Answer to the Global Quality Challenge: A National Quality Infrastructure. Braunschweig: PTB.

Shepherd, B. (2014). Product Standards and International Trade Negotiations: A Practical Guide. Geneva: Trade Advocacy Fund. http://www.tradeadvocacyfund.com/toolkitsvol2.

Shepherd, B. (Forthcoming). "Product Standards, International Harmonisation, and Export Diversification." Journal of Economic Integration.

Shepherd, B., and N. Wilson. (2013). "Product Standards and Developing Country Agricultural Exports: The Case of the European Union." Food Policy, 42: 1-10.

Standards Council of Canada (2003). The Benefits of Accreditation for Developing Countries.

WTO (2005). World Trade Report 2005.

WTO (2014). Existing Definitions of Private Standards in Other International Organisations: Note by the Secretariat.

GLOSSARY

- **Accreditation** is related to conformity assessment, and refers to independent evaluation of testing and calibration laboratories, management systems, inspection bodies, personnel and so on, to confirm compliance with internationally recognised standards and requirements.

- **Adoption** (of an International Standard as a regional or national standard): Publication of a national or regional normative document based on a relevant International Standard, or endorsement of an International Standard as having the same status as a national normative document, with any deviations from the International Standard identified.

- **Calibration**: Essentially the comparison, under specified conditions, with a higher standard, which is traceable to a national or international standard, or an acceptable alternative.

- **Certification** third-party attestation (i.e. issue of a statement) that specified requirements related to products, processes, systems or persons have been fulfilled (formally establishes, after evaluation, testing, inspection or assessment).

- **Conformity Assessment Bodies** (CABs): Testing and calibration laboratories, certification bodies as well as inspection bodies that provide conformity assessment services.

- **Conformity Assessment**: is to be understood as involving the "demonstration that specified requirements [i.e. technical regulations and standards] relating to a product, process, system, person or body are fulfilled."

- **Harmonised standards**: Standards on the same subject approved by different standardising bodies that establish interchangeability of products, processes and services, or mutual understanding of test results or information provided according to these standards.

- **Inspection**: The examination of a product design, product, process or installation and the determination of its conformity with specific requirements or, on the basis of professional judgment, with general requirements.

- **Metrology:** The measurement for the determination of conformance to technical requirements including the development of standards and systems for absolute and relative measurement.

- **Product**: The result of a process, i.e. a set of interrelated or interacting activities which transforms inputs into outputs, of which four generic categories are services, software, hardware and processed materials.

- **Service**: The result of at least one activity necessarily performed at the interface between the supplier and the customer, which is generally intangible.

- **Specifications**: Tolerances, limiting values and other defining characteristics for materials, products, services, processes, systems or persons, contained within the provisions of a standard.

- **Standards**: A standard is a published: "specification that establishes a common language, and contains a technical specification or other precise criteria and is designed to be used consistently, as a rule, a guideline, or a definition". Other definition: “Standards are voluntary agreements, developed within an open process that gives all stakeholders, including consumers, the opportunity to express their views and have those views considered”.

- **Standardisation**: Activity of establishing, with regard to actual or potential problems, provisions for common and repeated use, aimed at the achievement of the optimum degree of order in a given context.

- **Testing**: determination of one or more characteristics of an object of conformity assessment, according to a procedure (typically applies to materials, products or processes).

- **Technical regulation**: Document which lays down product characteristics or their related processes and production methods, including the applicable administrative provisions, with which compliance is mandatory. It may also include or deal exclusively with terminology, symbols, packaging, marking or labelling requirements as they apply to a product, process or production method.

(Source: ISO, BSI, and UNECE)

ANNEX I[77]. PARTICIPATION OF APEC MEMBER ECONOMIES IN INTERNATIONAL STANDARDS AND RELATED BODIES.

Participation of APEC Member Economies in International Standards and Related Bodies

	ISO					IEC			Codex	BIPM	OIML	IAF	ILAC
	Membership	P Member	O Member	TC	PDC	Membership	P Member	O Member					
Australia	1	296	88	389	3	1	110	58	1	1	1	1	1
Brunei Darussalam	1	-	9	6	3	0			1	0	0	0	0
Canada	1	327	51	375	3	1	98	12	1	1	1	1	1
Chile	1	97	72	166	3	1	0	2	1	1	0	1	1
People's Republic of China	1	693	38	730	3	1	178		1	1	1	1	1
Hong Kong, China	1	-	250	247	2	0			0	0	1	1	1
Indonesia	1	100	153	247	3	1	23	41	1	1	1	1	1
Japan	1	638	78	708	3	1	176	2	1	1	1	1	1
Republic of Korea	1	553	174	725	3	1	134	35	1	1	1	1	1
Malaysia	1	162	122	282	3	1	27	66	1	1	1	1	1
Mexico	1	89	46	129	3	1	36	55	1	1	1	1	1
New Zealand	1	63	117	174	3	1	18	101	1	1	1	1	1
Papua New Guinea	1	-	5	4	1	0	-	-	1	0	1	0	1
Peru	1	37	9	41	3	0	-	-	1	0	1	1	1
The Philippines	1	42	93	131	3	1	14	19	1	0	0	1	1
The Russian Federation	1	583	67	642	3	1	145	33	1	1	1	1	1

[77] Data accessed in October 2017. As of February 2018, data for Peru is as follows: P member = 38; TC = 43; PDC = 4.

Singapore	1	71	93	162	3	1	16	59	1	1	1	1	1
Chinese Taipei	0	-	-	-	-	0	-	-	0	0	1	1	1
Thailand	1	100	206	304	3	1	24	56	1	1	1	1	1
The United States	1	592	8	598	3	1	164	-	1	1	1	1	1
Viet Nam	1	19	72	88	3	1	4	-	1	0	1	1	1

Source: Organisation websites.

ANNEX II[78]. PARTICIPATION OF APEC MEMBER ECONOMIES IN REGIONAL STANDARDS BODIES

Participation of APEC Member Economies in Regional Standards Bodies

	APLAC	APLMF	APMP	PAC	PASC
Australia	1	1	1	1	1
Brunei Darussalam	1	1	0	1	1
Canada	1	1	0	0	1
Chile	0	1	0	0	0
People's Republic of China	1	1	1	1	1
Hong Kong, China	1	1	1	1	1
Indonesia	1	1	1	1	1
Japan	1	1	1	1	1
Republic of Korea	1	1	1	1	1
Malaysia	1	1	1	1	1
Mexico	1	1	0	1	1
New Zealand	1	1	1	1	1
Papua New Guinea	1	1	1	1	1
Peru	1	1	0	1	1
The Philippines	1	1	1	1	1
The Russian Federation	1	1	1	1	0
Singapore	1	1	1	1	1
Chinese Taipei	1	1	1	1	0
Thailand	1	1	1	1	1
The United States	1	1	1	1	1
Viet Nam	1	1	1	1	1

Source: Organisation websites

[78] Data accessed in October 2017.

ANNEX III. ICS FIELDS AND DEFINITIONS

ICS fields and definitions.

ICS	Field
1	Generalities. Terminology. Standardisation. Documentation
3	Services. Company organisation, management and quality. Administration. Transport. Sociology
7	Natural and applied sciences
11	Health care technology
13	Environment. Health protection. Safety
17	Metrology and measurement. Physical phenomena
19	Testing
	Analytical chemistry, see 71.040
21	Mechanical systems and components for general use
23	Fluid systems and components for general use
	Measurement of fluid flow, see 17.120
25	Manufacturing engineering
27	Energy and heat transfer engineering
29	Electrical engineering
31	Electronics
33	Telecommunications. Audio and video engineering
35	Information technology
37	Image technology
39	Precision mechanics. Jewellery
43	Road vehicles engineering
45	Railway engineering
47	Shipbuilding and marine structures
49	Aircraft and space vehicle engineering
53	Materials handling equipment
55	Packaging and distribution of goods
59	Textile and leather technology
61	Clothing industry
65	Agriculture
67	Food technology
71	Chemical technology
73	Mining and minerals
75	Petroleum and related technologies
77	Metallurgy
79	Wood technology
81	Glass and ceramics industries
83	Rubber and plastic industries
85	Paper technology
87	Paint and colour industries
91	Construction materials and building

93	Civil engineering
95	Military affairs. Military engineering. Weapons
97	Domestic and commercial equipment. Entertainment. Sports

Source: www.iso.org.

ANNEX IV: PSU QUESTIONNAIRE

The APEC Policy Support Unit has been requested by the Sub-Committee on Standards and Conformance (SCSC) to administer a survey on quality infrastructure in APEC member economies. The aim of the questionnaire is to collect data that can be used to compute performance indicators that can inform SCSC stakeholders. Respondents are requested to respond in concrete, quantitative terms whenever possible, but space is also left for additional qualitative information they would like to bring to PSU's attention. The output of this exercise will be a dashboard or index that will inform SCSC's future work, so respondents are encouraged to respond as fully and accurately as possible with the aim of establishing a strong baseline for performance tracking.

For questions on sectoral breakdowns, respondents are directed to the following macro-sectors based on the International Classification of Standards (ICS) fields, as indicated: general manufacturing (Fields 21-27; 39, 43, 45, 47, 49, 59, 61, 71, 77, 79, 81, 83, 85, 91); electronics and telecommunications (Fields 29-37); food and agriculture (Fields 65 and 67); services (Field 3); healthcare and medical devices (Fields 7, 11 and 13); and extractive industries (Fields 73 and 75).

1. Which aspects of national quality infrastructure are currently available in your economy? How are these institutions being funded?

Quality Infrastructure	Public	Private	Main sources of funding
□ Metrology institutions	□	□	□ Government □ Industry □ Self-supporting (i.e. revenue from sales or services)
□ Accreditation bodies	□	□	□ Government □ Industry □ Self-supporting (i.e. revenue from sales or services)
□ Testing laboratories	□	□	□ Government □ Industry □ Self-supporting (i.e. revenue from sales or services)

□ Certification bodies	□	□	□ Government □ Industry □ Self-supporting (i.e. revenue from sales or services)
□ Standards bodies	□	□	□ Government □ Industry □ Self-supporting (i.e. revenue from sales or services)
Others:…….	□	□	

2. How is the level of engagement of private sector (e.g. board memberships, regular consultations, etc.) in the following aspects of national quality infrastructure?

	Board membership	Regular consultations	Others (please describe)
Standards bodies			
Metrology institutions			
Accreditation bodies			
Testing laboratories			
Certification bodies			

3. How many standards have originated from Governments? How many voluntary standards have originated from the private sector? What consultation processes are implemented in development and review of standards? (Encompassing, for example, OIML recommendations [legal metrology].) How many standards are referenced in regulation and legislation?

	Number of standards being proposed (provide the figures for the last three years)	Consultation processes involved (e.g. public/private, etc.)	Standards being referenced in regulation and legislation (number)

Governments			
Private sector			

4. How many new standards/accreditation programs have been developed in the last three years?

5. How many bodies are available to provide conformity assessment related services? Can a sectoral breakdown be provided using the ICS classification above?

Quality Infrastructure	**Services provided**	**Number of bodies**	**Number of accredited bodies (If yes, please indicate the international standard according to which the body was accredited)**	**Number of certificates and test reports issued**	**Need for modernisation (Please describe)**
Metrology institutions					
Accreditation bodies					
Testing laboratories					
Certification bodies					
Others: ……					

6. List down three to five most important capacity building and/or collaboration activities being implemented by your agency last year and provide a brief explanation, as well as indicating why they have been considered important.

Capacity building and/or collaboration activity	Importance of activity
a.	
b.	

c.	
d.	
e.	

7. What is currently the approximate number of **national standards** (set by national standards bodies) and **private standards** (standards developed by private entities; such as companies, non-governmental organisations or multi-stakeholder coalitions)? Can a sectoral breakdown be provided using the classification above?

	National standards (fill in the appropriate numbers or percentage)	Private standards (fill in the appropriate numbers or percentage)
Standards		
Sectoral breakdown:		
• General manufacturing		
• Electronics and telecommunications		
• Food and agriculture		
• Services		
• Healthcare and medical devices		
• Extractive industries		

8. What is the percentage of standards used in technical regulations? Can a sectoral breakdown be provided using the ICS classification above?
9. What proportion of your economy's standards are harmonised or aligned with international standards (e.g., ISO, IEC, ITU, or Codex)? Can a sectoral breakdown be provided using the ICS classification above?

	ISO	**IEC**	**ITU**	**Codex**	**Others:_____**
Percentage alignment with international standards					
Sectoral breakdown:					
• General manufacturing					
• Electronics and telecommunications					
• Food and agriculture					
• Services					
• Healthcare and medical devices					
• Extractive industries					

10. Does your economy have any mutual recognition agreements covering conformity assessment and metrology? If so, with which other economies? Please also describe briefly on the effectiveness of these agreements, and their relevance to the needs of your economy.

	Mutual recognition agreements signed (please list the names)	Partner economies	Effectiveness	Relevance
Conformity assessment				
Metrology				

11. Does your economy maintain any data on business uptake of standards services delivered by conformity assessment and metrology infrastructure? If so, what are the most recent results? Can a sectoral breakdown be provided using the ICS classification above?

	Number of firms	Type or name of standards/services
Sectoral breakdown:		
• General manufacturing		
• Electronics and telecommunications		
• Food and agriculture		

• Services		
• Healthcare and medical devices		
• Extractive industries		
Total		

12. Does your economy maintain any data on consumer awareness and confidence to use certified products and accredited services? If so, what are the most recent results? Can a sectoral breakdown be provided using the ICS classification above?

13. What are the key resources required for maintaining and enhancing the current standards and conformance infrastructure? What are the key benefits? (please provide ranking, with 1 as the most favorable)

Key resources	**Perceived benefits**
□ Technological resources	□ Public safety and health
□ Maintenance	□ Quality products
□ Human resources	□ Market access
□ Physical infrastructure	□ Economic benefits
□ Equipment □ Strong regulatory framework	Others:…….
□ Others:…….	

14. What steps does your economy intend taking over the next three years to improve national quality infrastructure? Any specific objectives or (quantitative) targets? Please provide the latest strategic document pertaining with quality infrastructure.

15. Does your economy engage in outreach programs to communicate the importance of standards and conformance? Please provide a short description.

16. Does your economy have a process in place to develop national standards based on future needs? Please provide a short description.

17. How many standards and conformance institutions have adopted the WTO TBT Agreement Code of Good Practice?