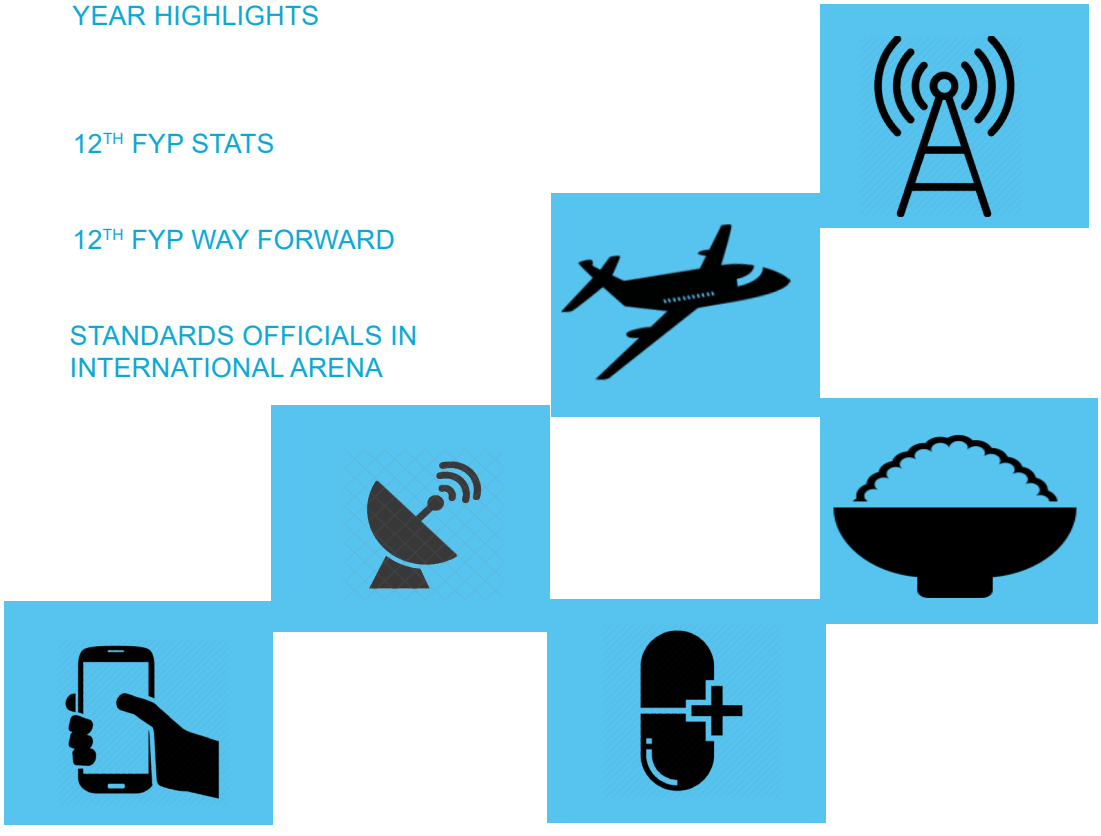
BHUTAN STANDARDS BUREAU

2018-19

2018 ANNUAL REPORT



World Standards Day 2019

14 October 2019

Video standards create a global stage

Profile

VISION

To be the center of excellence in Standards, Metrology and Conformity Assessment services

MISSION

To promote and provide market relevant Standards, Metrology and internationally recognized Conformity Assessment for industry, commerce, government and the society

Message from Head

Quality has become a catchphrase and every person or high ranking officials stress on it. However, what constitutes quality is highly subjective and is best known to the person quoting it. We at Bhutan Standards Bureau, believe that quality starts with standardisation. Be it products, services or processes, standards is the starting point when talking of quality.

At the onset of 12 FYP, the government has made sure that standards gain a place in all the developmental programmes. As standards division, with support from the experts and stakeholders, we have ensured that relevant standards will be formulated meeting the needs of current market trends and in keeping with the developmental pace. To ensure that crucial social development sectors meet the people's aspirations standards are now being felt increasingly necessary, be it for water supply, road construction or even for meals provided in our schools.To this, we have ensured that standards are referred to in the new acts, policies, strategies and other government programme documents. Further with rapid increase in young entrepreneurs in the country, standards has become more relevant and the demand has been growing steadily. This is a welcome development for the standardisers.

Another welcome development has been an increase in budget allocation for the standardisation works for the 12 FYP. Additionally, stakeholders have come up with their own budgetary support for the standardisation works especially from the department of cottage and small industries as part of flagship program to promote SMEs. Regional harmonisation of standards is also being pursued to enable our products gain access to the eight SAARC member countries with one common standard. Participation to international forums has also yielded positive outcomes for the standardisers. We are looking forward to participating in international forums as full fledged member with the experience gained in the coming years.

The coming year is filled with expectations of greater demand for our standards and active engagement by our stakeholders. This is because of the numerous stakeholder engagements carried out by the division in the past years as is evidently clear from the numerous enquiries received by the standards promotion section.

We thank our experts and stakeholders who have contributed immensely and congratulate them for their success in the national standards development works.

Best Wishes to Standardisers !!

Technical Committees

1

TC 01-Civil Engineering Standards Technical Committee

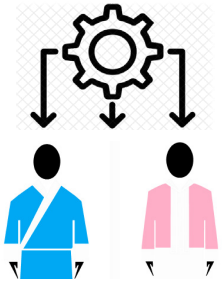
2

TC 02-Food and Agriculture Standards Technical Committee

3

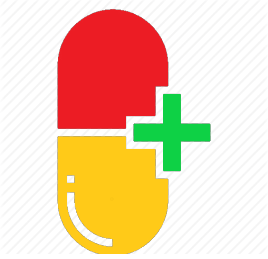
TC 03-Electrical and Electronics Engineering Technical Committee

4



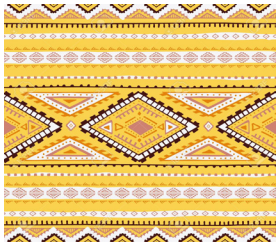
TC 04-Basics and Management System Standards Technical Committee

5

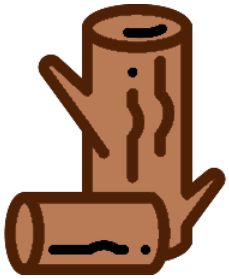


TC 05-Pharmaceuticals and Traditional Medicines Standards Technical Committee

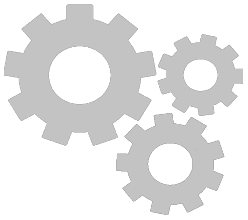
Technical Committees

6 

TC 06-Textiles Standards Technical Committee

7 

TC 07-Wood and Timber Products Standards Technical Committee

8 

TC 08-Mechanical Engineering Technical Committee

9 

TC 09-Graphical Symbol Standards Technical Committee

10 

TC 10-Sustainability and Environment Standards Technical Committee

Standards At a Glance

A PORTFOLIO OF

246

BHUTAN STANDARDS SPREAD ACROSS KEY SECTORS

A INCREASE IN STANDARDS

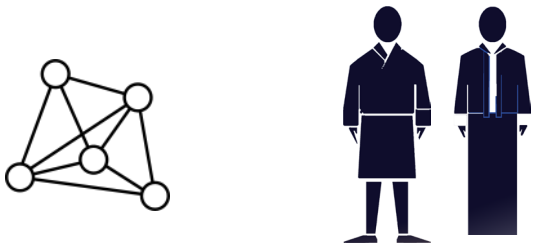
100%

FOR FOOD AND AGRICULTURAL PRODUCTS

45%

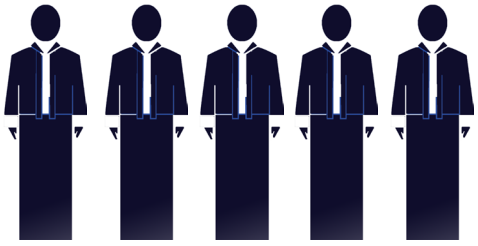
INCREASE IN INTERNATIONAL STANDARDS ADOPTIONS

About Standardization Division



Stakeholders from government, regulators, industries and SMEs

Increased engagement with regulators and industries



Women experts (73%) lead in Techincal Committee on Textiles

Key Figures

245

Bhutan Standards

17

Technical Committees and subcomittees

193

Experts from Industries, test and research, labs, governments, consumer groups

>10000

Access to International Standards

25

TC Meetings

706411

Sms delivered on W.S.D

Nu. 0.60 Mn

Standards Development Budget (10 TC)

Year Highlights 2018-2019

High level sensitization on National Standards

A high level sensitization workshop on the importance of national standards to the national economy, how it ensures safety, quality and contributes to the national development was presented to the Good Governance Committee of the National Council (NC) on the 24th January, 2019 at the NC conference hall and for the National Assembly members it was conducted on 26th April at the Le Meridien. The importance of national standards, how it can benefit the economy and development of the country was emphasised.

National Focal Points workshop

To facilitate maximum participation of our key national stakeholders in the development of national standards, one day national focal points workshop was conducted at FITI, Thimphu on 30th April, 2019. The focal points were presented with standardisation processes, methodology and its use in regulations, rules, and for other developmental uses.

Standards Australia and ISO Twinning meeting

As part of the ISO New Rights program, standardization division proposed for ISO twinning program under TC-04 Basics and Management Technical committee with Standards Australia on 4th March, 2019. The ISO twinning arrangement provides support for the national mirror committees to build their capacity on standards development and technical knowhow on the matter related to international standardization process. The ISO twinning program will run alongside the SA's proposal program on Indo-Pacific Digital Trade Standardisation.

Department of Agriculture, Ministry of Agriculture and Forests with financial support from WFP in developing national standards on Fortified Rice Kernel and Fortified Rice

Providing nutritious food to our children is one of the mandates of the government. Ensuring that past incidents of nutrient deficiency does not recur, the government has initiated steps to fortify the rice with the requisite dietary nutrients.To enable the government to meet this objective, requirement of national standards was seen to be the first step towards guaranteeing that rice provided to school going children meet the dietary required nutrient intake. Taking cognisance of the importance of national standards in the country, Department of Agriculture, being the Lead agency for Food Fortification with financial support from WFP provides full financial support to develop the national standards on Fortified Rice Kernel (Vitamin and Mineral Premix Kernel) and Fortified Rice. The fund supports all required committee meetings, logistical and capital needs for the standards formulation works. The fund support is for the FY 18-19 to FY 19-20. The first meeting was held on 8th-11th May, 2019.


12th FYP Stats

Division Stats

1.Standards development works for FY 18-19

The total number of Bhutan Standards stands at 245 as of FY 18-19. National standards are formulated under the ten technical committees which are approved and endorsed by the BSB Board. The standards are formulated following the best practises of ISO and international standards bodies. For a national standard to be formulated, the technical inputs are provided by the experts from the industry, regulators, academia and the government. BSB provides the necessary logistical, secretarial and the fund support for standards formulation works.

Sl.No	Particulars	Figures	Remarks
1	Finalised National Standards	2 BTS finalised 1.BTS 139: 2019 SARS 0014: 2018 Food Hygiene- General Principles- Code of Practice 2.BTS 267: 2019 IS 308: 1988 (Reaffirmed 2016) - identical adoption-Specification for Dissolved Acetylene(Gas)	Endorsed by 10th BSB Board meeting on 12/07/2019
2	National standards in works at hand	i.18 in Working Draft stage ii.9 in Committee Draft stage	For FY 18-19 For FY 18-19

2.Stakeholder Engagement

Standardisation Division participated in a number of workshops and meetings conducted by the stakeholders. As part of stakeholder engagement, standards officials participated in the meetings and workshops to facilitate the standards usage, adoptions and referencing in their strategies, rules and regulations, technical regulations and other policy documents for their sectors.

Ministries	6
Regulators	4
Industries	1
Academia	1

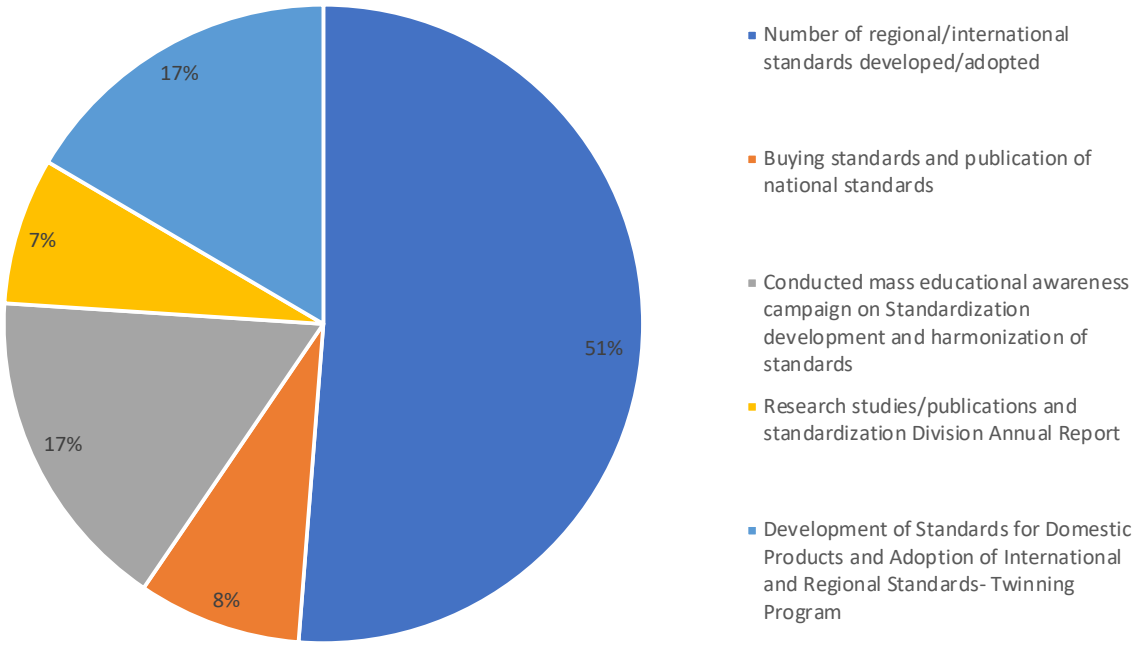
SARSO Standards

Bhutan being a member to SAARC, is a signatory to the SARS agreement. This body is instituted to develop SAARC regional standards for the SAARC member countries. SAARC Regional Standards are developed through the Sectoral Technical Committee formed under the SARSO Directives. One regional standard enables easy trade of commodities and services across the member countries. As of now, only eight SAR standards have been finalised.

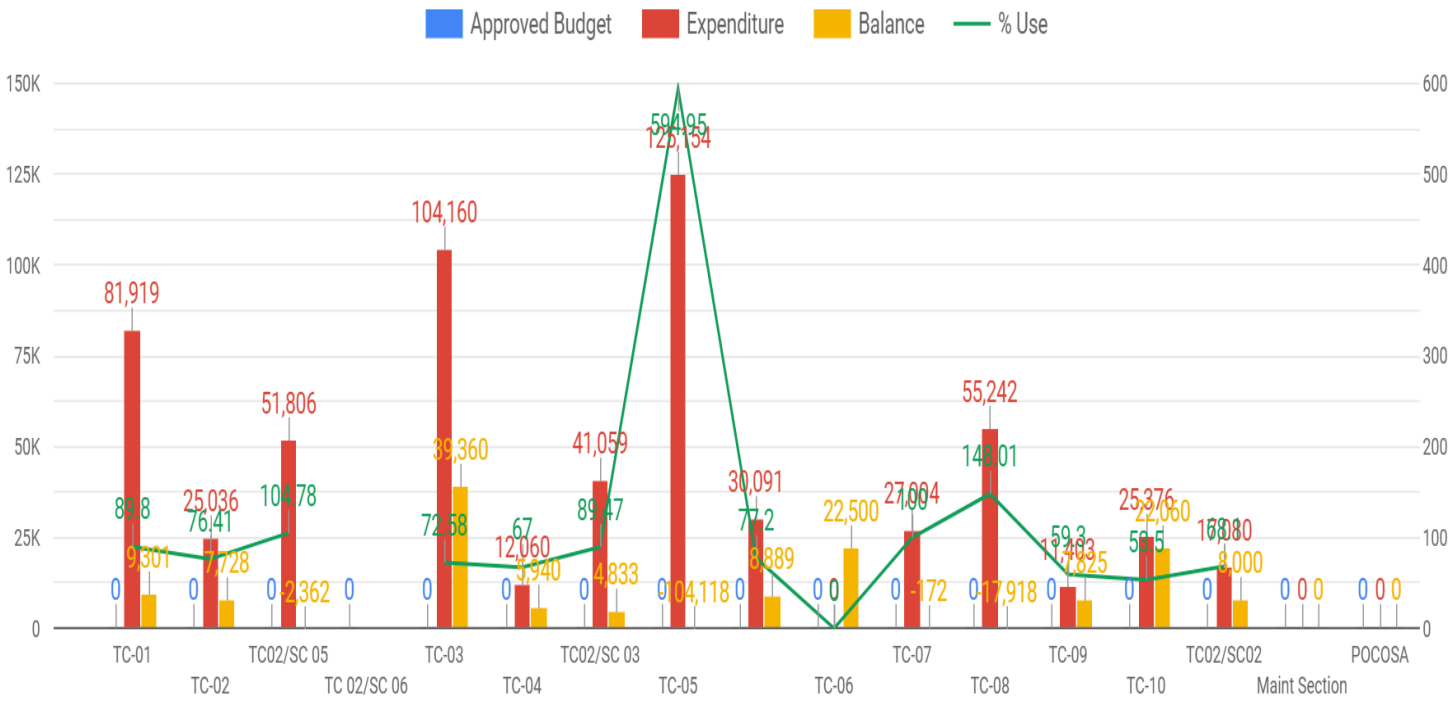
Name of STC	Number of finalised SARs	Particulars of Standards
STC 1 -Food and Agriculture Products	4	1.SARS 0006:2017 SAARC Standards on Biscuits - Specification; 2.SARS 0007:2017 SAARC Standards on Refined Sugar- Specification; 3.SARS 0008:2017 SAARC Standards on Code of Hygienic practice for Dairy Industry. 4. SARS 0014: 2018 Food Hygiene-General Principles- Code of Practice
STC 2-Jute,Textile and Leather	0	
STC 3-Building Materials	5	1.SARS/ISO 8491:1998 - Metallic materials -- Tube (in full section) -- Bend test (adoption from ISO) 2.SARS/ISO 6892-1:2016 - Metallic materials -- Tensile testing -- Part 1 Method of test at room temperature (adoption from ISO) 3.SARS/ISO 6892-2:2011 - Metallic materials -- Tensile testing -- Part 2 Method of test at elevated temperature (adoption from ISO) 4.SARS/ISO 8492:2013 - Metallic materials -- Tube -- Flattening test (adoption from ISO) 5.SARS/ISO 7438:2016 - Metallic materials -- Bend test (adoption from ISO)
STC 4-Electrical ,Electronics,Telecom and IT	2	1. SARS IEC 61195:1999, Double-capped fluorescent lamps - Safety Specifications 2. SARS IEC 60081:1997, Double-capped fluorescent lamps - Performance Specifications
STC 5- Chemical and Chemical Products	0	
Total SARSO Standards	11	

12TH FYP BSB budget outlay

Nu.10 Million

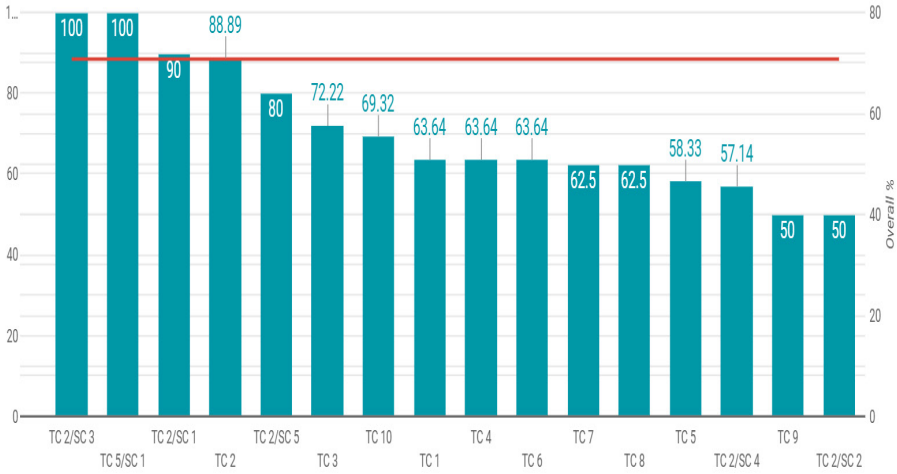


Technical Committee Budget Activity wise Activity wise

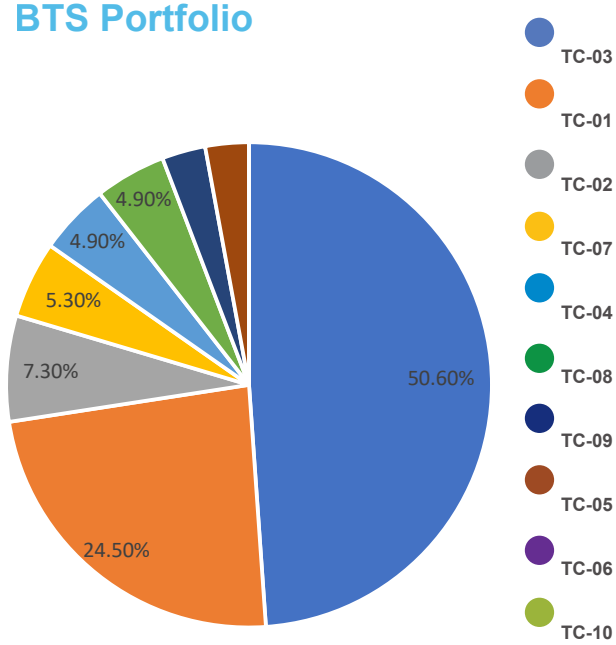


Standards Formulation Works

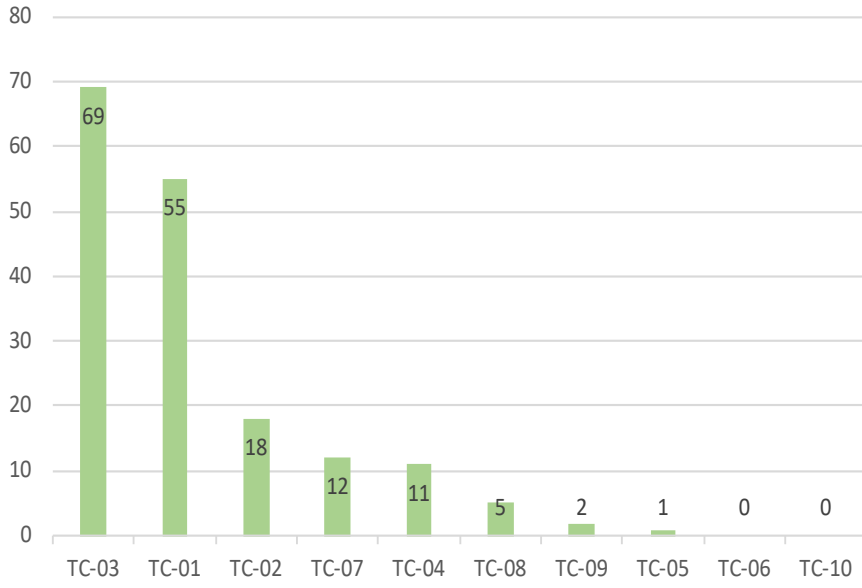
Technical Committee Attendance



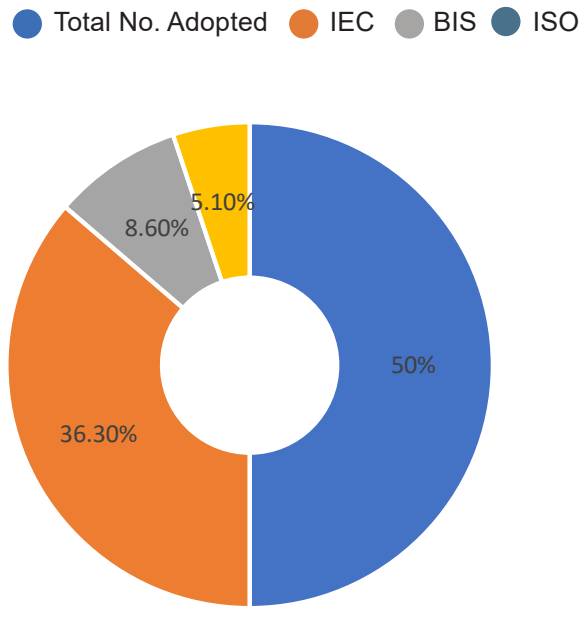
BTS Portfolio



BTS by Technical Committee

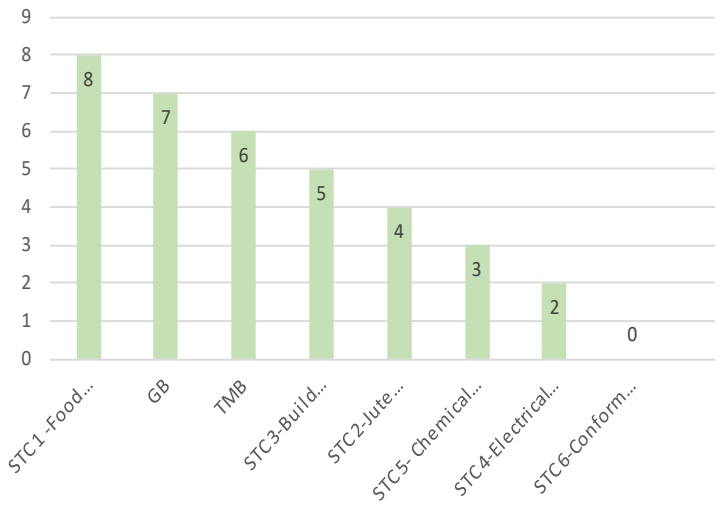


Adopted BTS from International Standards Bodies

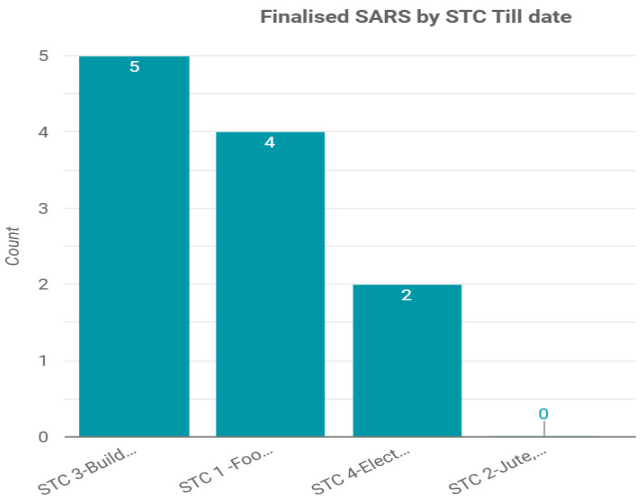


FY 18-19 SARSO Details

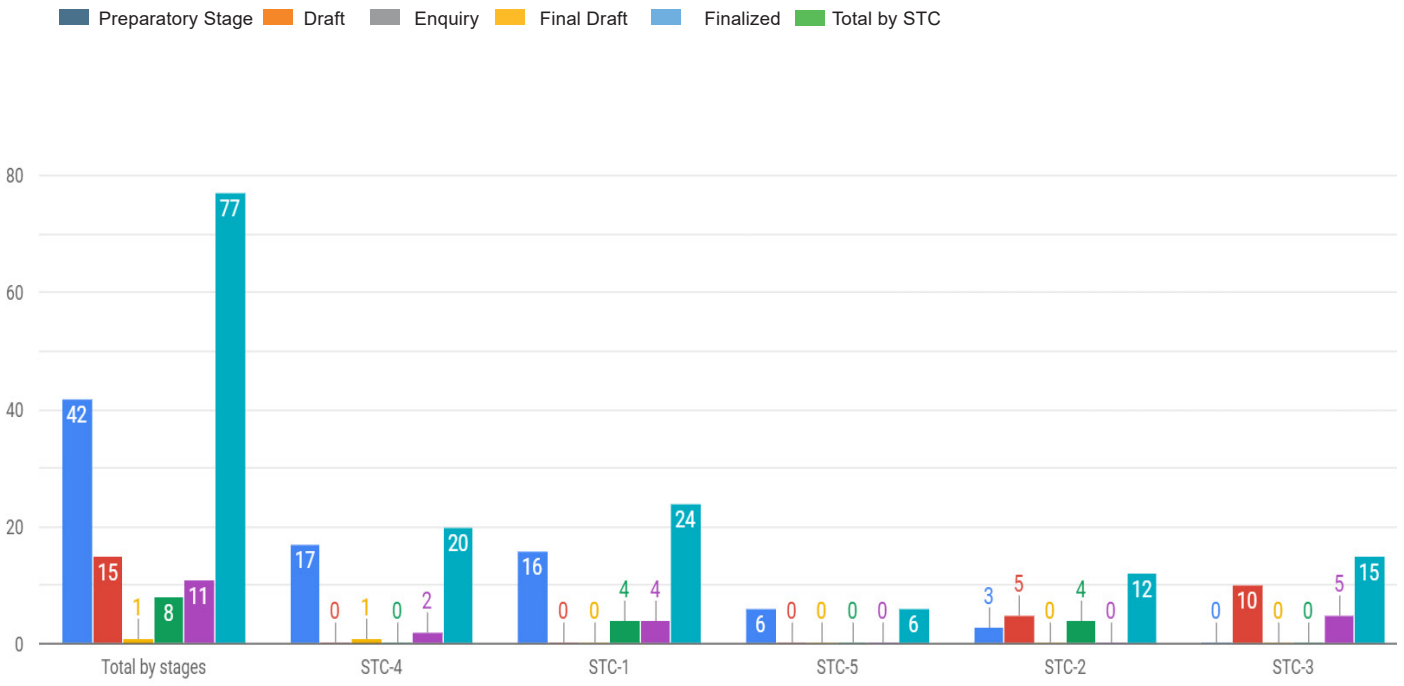
GB/TMB/STC Meetings Conducted Till date



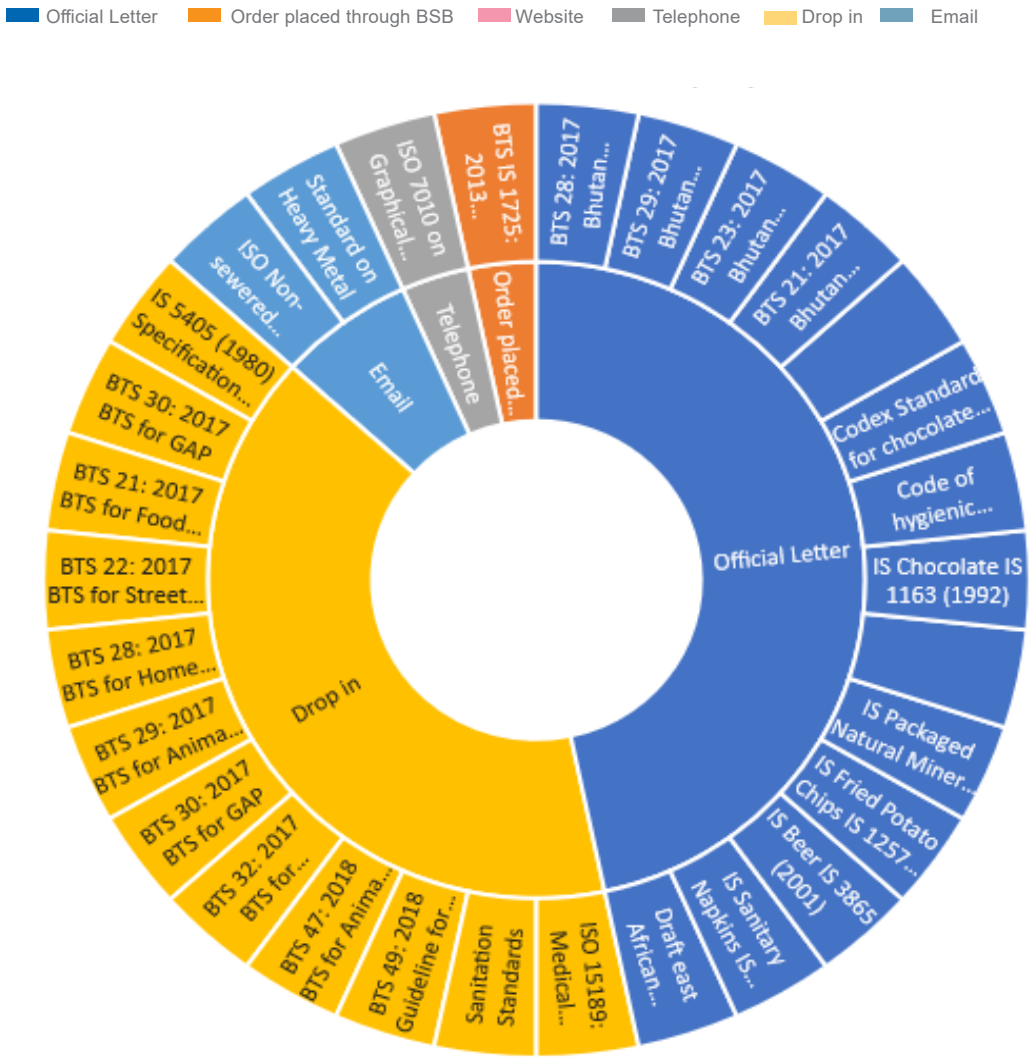
Finalised SARS by STC Till date



SARS by Stages across STC Till date



Breakdown of Stakeholder Engagement



Standards Enquiry by:

39% Walk in

20% eMail

46% Official letter

4% Telephone

Enhancing Member's Capabilities

1

39 STANDARDS FOCAL OFFICERS FROM THE STAKEHOLDERS TRAINED ON HANDS ON ONLINE VOTING AND COMMENTING

2

ALL STANDARDS OFFICIALS PARTICIPATED WITH STANDARDS AUSTRALIA ON ISO GOOD STANDARDIZATION PRACTISE TOOL ASSESSMENT

3

TC-02 MEMBER SECRETARY PARTICIPATED ON NATIONAL CODEX COMMITTEE PROJECT INCEPTION WORKSHOP AT NEW DELHI

4

3 STANDARDS OFFICAILS PARTICIPATED IN INTERNATIONAL STANDARDIZATION

12th FYP WAY FORWARD

Capacity Building in Numbers

CAPACITY BUILDING PLAYS AN IMPORTANT ROLE IN STANDARDIZATION

2
High level sensitization on standards

1
Standards Workshop for Focal point

5
Regulators engagement

2
Standards officials attend Regional Meetings

3
Officials participated in international Standardization

39

FOCAL POINTS

BSB PARTICIPATION IN REGIONAL AND INTERNATIONAL PLATFORMS IS CRUCIAL FOR STANDARDS HARMONIZATION WORKS

4

REGULATORS ENGAGED

STAKEHOLDER ENGAGEMENT FORMS THE CORNER STONE PRIORITY FOR STANDARDS IMPLEMENTATION

193

EXPERTS

ENGAGING NATIONAL STAKEHOLDERS PLAYS A KEY ROLE IN DEVELOPMENT OF STANDARDS

1. Research on Standardization

As standards play a key role in the economic and social development of the country, the division will undertake to study the level of standardisation in the country across sectors and agencies. This study will provide the crucial gaps and standardisation requirements for each sector. Further, it will also highlight areas of concern for the national standards development works with actionable items for improvement and support. While Bhutan has been slow in setting up its quality infrastructure systems in comparison with other developing countries, each sector through its own initiatives had ensured a certain level of standardisation had been achieved. Although a concerted effort to standardisation had been lacking in the past years,sectors have carried their standardisation activities within their scope and acquired the current levels of standardisation. It is expected that this study will guage the curent levels of standardisation and hence the research topic for this study is appropriately named as the how standardised is the country.
(research paper in annexe)

2. Standards for Flagship programs

The government has placed importance of standards for its Department of Cottage & Small Industries flagship program. Under this flagship program numerous agricultural and manufactured products are to be produced for which standards will need to be developed. From this flagship program atleast 20 products have been earmarked for development in two years period.Relevant Technical committees for these products shall initiate standards formulation works with 10 standards targeted in the first year and another 10 standards in next fiscal year. With standards formulation works,other awareness programs are also planned for the year. The government has earmarked budget for the flagship programs and also for the standards formulation works.

3. 12th FYP Standards Overview

The division with inputs from its technical committees experts and the national focal points strived to develop the national standardisation strategy for the 12 FYP in the past year. With inputs from sectors and agencies, the draft strategy was formulated and shared to stakeholders. However due to poor responses, the strategy could not be finalised as the numbers of standards required were highly skewed to certain sector, notably hydropower sector. This resulted in unbalanced work load and resource allocation rendering other technical committees with no standards to formulate. Despite the initiative, the division will take up the standards requested by agencies in coming years and shall be taken up in relevant technical committees.

Sl.No	Sectors	No of Standards
1	Ministry of Agriculture and Forest	15
2	Druk Green Power Corporation	1407
3	Bhutan Electricity Authority	2
4	Bhutan Power Corporation	36
5	Ministry of Finance	5
6	Bhutan Hydropower Services Limited	17
7	Drug Regulatory Authority	10
	Total	1492

Standards Officials in International Arena

WHO Workshop on Clean Cookstoves

Mr. Phurpa Wangdi attended the WHO workshop on clean cookstoves and clean cooking solutions at Kathmandu, Nepal from 11th -13th December 2018.

'The Workshop informed the key stakeholders on standards for testing clean cookstoves and clean cooking solutions to meet the WHO guidelines for Indoor Air Quality: Household Fuel Combustion.

It was a privilege for me to take part in the workshop to learn about how standards would improve the efficiency of cookstoves and make a difference in the lives of marginalized people using conventional cookstoves'.

Attending the first meeting of ISO TC 323 on Circular Economy at Paris during 19th to 23rd May 2019 was my first ever experience at an International activity for standardization. It was an immense pleasure for me to be a part of an international event participated by 140 delegates representing 40 ISO Member Countries.

Being the first meeting of the Technical Committee, it was a perfect opportunity to learn setting foundation for a newly established technical committee; including defining Scope of the Technical Committee, drawing Strategic Business Plan of the Technical Committee, and establishing internal and external liaisons.

Besides, the social events, lunch and coffee breaks provided the right networking platforms to meet with new people, and to build connection to a group of people who are passionate about the same thing. Attending an international meeting was an extremely inspiring and enriching experience both for my professional development and for my personal fulfillment.

I hope my experience will inspire our colleagues to participate at any other international events and forums.

Attended Indo-Pacific Digital Trade Standardization Initiative in Dhaka , Bangladesh on 6-7th August 2019.

Digital technologies are transforming global trade and business, presenting new opportunities for the Indo-Pacific region. Through the adoption and use of international standards, countries will be better equipped to realize the many benefits of digital trade.

Annexure

How much standardized is a country?

Proposal of a synthetic index to measure the degree of standardization in a country.

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Abstract— Standards affect our lives, impacting on trade, legislation, innovation, certification and other related activities. We understand and quantify some of those impacts, but we are not able to measure and rank the overall impact of standardization in a single country.
Using the methodology to construct aggregated indexes, we propose the creation of a standardization index, based on indicators related to the availability of standards, the use of standards and the resources allocated to standardization activities. We built the index considering nine countries and 11 indicators.
The results show two slightly different ranks, with the best aggregated achievement in individual indicators or the most balanced solution. Both ranks are led by Asian countries. The discussion shows that some indicators could be improved incorporating the size of the economy and performing a sensitive and correlation analysis.
We concluded that the methodology is suitable for the intended purpose, the results are coherent with the general appreciation and further studies revising the indicators are recommended.
Index Terms—Standardization, index, synthetic index, indicator, ranking, standards, impact, country.

I.INTRODUCTION

Standards are present in almost all human activities and have an increasing importance through their impact on trade, legislation, innovation, patents and quality infrastructure activities. There are several studies explaining and trying to explain and quantify the impacts of standardization in those activities. However, most of the impacts of standardization are extremely difficult to measure and, therefore attempts have followed different approaches, e.g. for the economic impact there are macroeconomic [1-10] and microeconomic studies as well as case studies [11].
Nevertheless, there are no studies with a comprehensive approach on the importance of standardization itself, without focusing on single type of impacts. Therefore, a major challenge for standards is to standardize a way to measure its impact and importance.
On the other hand, indexes are a tool widely used to simplify complex issues. Examples of indexes are; GDP, inflation, development, inequality (Gini), digitalization (ITU), stock markets, etc. The indexes succeeded because a combination of indicators has a stronger meaning than individual data. E.g. you cannot deduct anything about the cost of life from a variation in the price of a computer, but you can do it combining the price variation of various goods; computer, milk, fuel, etc.
Using the same principle, this paper proposes to create an index on standardization, combining different indicators. Those indicators might not have a very strong meaning by themselves, but the combination of all of them should result in a meaningful ranking of countries showing the importance of standardization in them and answering the question, how much standardized is this country?
The answer to this question is relevant for different stakeholders and especially for the standardization bodies and the policy makers. To develop standards and promote its use is the primary task of the standardization bodies, which are usually supported by the governments, as the standardization is considered an strategic in many countries, e.g. in Europe [12-13]. A successful index should allow comparisons between countries or sectors and show a time evolution and is a good tool to allocate resources and to check the results of the actions previously taken.

II.METHODS

A.Indicators and countries chosen

For this paper we have chosen indicators representing the following issues; availability of standards, use of standards and resources allocated to standardization activities. The indicators are shown in Table 1. We conducted the study with countries having different levels of economic and industrial development from different regions. From an initial selection of over 13 countries, we took only those countries with available data for all the proposed indicators.
The resources allocated to standardization were taken from the following indicators; the membership and secretariats in ISO and IEC technical committees, the missed ballots in ISO and the proposed standards in IEC. As indicators for the availability of standards we choose the size of catalogue and the prize of ISO 9001 individually purchased through the National Standardization Body or equivalent. The use of standards has been taken from certification and accreditation activities, based on standards and from the number of standards cited in

national legislation.

Indicators Used Indicators from data at country level	Code	Type	Overall meaning
Membership in ISO	ISO-Memb	+	Resources allocated to standardization
Secretariats in ISO	ISO-Sec.	+	
Missed ballots in ISO	ISO-Ball.	-	
Membership in IEC	IEC-Memb	+	
Secretariats in IEC	IEC-Sec.	+	
Proposed IEC standards	IEC-Prop	+	
Active standards in national catalogue	Act-Std	+	Availability of standards
Price of ISO 9001 individually purchased	9001-Price	-	
Standards cited in legislation	Leg-STD	+	Use of standards
Certificates issued with ISO 9001	9001-Cert	+	
International agreements on accreditation	Accred.	+	
schemes based on standards			

The resources allocated to standardization ideally should be taken from the budget and the participants at national level, but this data are not easy to find and could not be comparable at all. One of the main reasons to choose an alternative indicator is because not all the National Standardization Bodies (NSB) offer the same services, e.g. some NSB include certification and training activities and it is not always possible to differentiate the budget of separated standardization activities. The number of participants at national level is not always public and often unknown.

Therefore, we have chosen the membership at ISO and IEC level, which is an indirect figure of resources allocated, as this membership is related to participation at national level and membership to ISO and IEC will imply a fee. Both ISO and IEC allow two kinds of membership for the technical committees and subcommittees; participant (P) and observer (O). Those kinds of membership have different fees, obligations and weight in the balloted decisions. Consequently, the indicator gives a higher weight to participant membership, as it implies more resources than observer membership.

The number of ballots in ISO is directly related to the membership in technical committees, so we skipped this data as it would be correlated with other indicators. Therefore, rather than the number of ballots, we decided to use the percentage of missed ballots with a negative interpretation. This indirectly means the balloting success of the NSB which can be considered as related to the resources allocated.

The availability of standards at national level has been taken using the active standards in the national catalogue. Initially it was also considered the number of purely national standards, i.e. those not adopted from other standardization bodies, typically regional or international. When going deeper, we realized that the percentage of purely national standard was not really suitable for two reasons; the level of equivalence with international standards is not homogeneously considered in all countries and those equivalences are not equally registered. Besides that, it can be argued that this equivalence is more indicative of the internationalization of the catalogue, rather than the availability.

Also for the availability of standards, we considered the price of ISO 9001 taken in US dollars. When the data were provided in local currency, we used the exchange rate by the 18th of April 2018. We opted for ISO 9001 as it is available almost everywhere and could be considered as a “benchmark” standard. It could be interesting to check the results with the price of a group of standards, e.g. ISO 14001, ISO/IEC 17000 series, etc.

We think the standards cited or referred in legislation is a relevant indicator because it shows the use of standards by a key stakeholder; the public authorities. As these data were not available for some of the countries initially considered, we decided to remove those countries without data from the results, rather than estimating data using statistical tools.

Some of the most relevant uses of standards are within the quality infrastructure, which comprises metrology, certification and accreditation. To assess the use in certification we considered the number of certificates issued under ISO 9001:2008 and ISO 9001:2015, considering both versions equally.
Accreditation has been included using the multilateral agreements and recognitions provided by the two most relevant international associations; the International Accreditation Forum (IAF) and the International Laboratory Accreditation Cooperation (ILAC). The first one (IAF) is focused on management systems, products, services, personnel and similar programmes of conformity assessment and ILAC is focused on laboratories. The multilateral agreements are based on standards, basically those from ISO/IEC 17000 series.
There are different levels of multilateral agreement existing at IAF; main, level 4 and level 5 [ref]. The indicator of accreditation was build giving different weights to each level of multilateral agreement and combining IAF and ILAC recognitions. The weights were assigned after a very limited survey to experts from the Spanish Accreditation body. For those countries with more than one accreditation body, we considered the total number of multilateral agreements under different standards. This means that a country with three accreditation bodies with multilateral agreements under the same standard will be counted only once.
The initial data proposed for accreditation activities were the number of accredited entities combined with the number of accreditation schemes based on standards, but though accreditation is a public activity, it was not feasible to find those data for all the countries studied. It could be interesting to do the study retrieving those data.
All the data used for this paper come from ISO, IEC, surveys to specific stakeholders, research in webpages of the National Standardization Bodies and perinorm [14]. The data on certifies companies comes from the ISO Survey of Management System Standards Certification [15].

B.Methodology
Once the indicators and the countries have been defined, the overall ranking of countries in terms of standardization can be derived by adapting the method proposed in [16-17]. First, a matrix with the values achieved by the indicators previously selected (Table 1) in each country (in alphabetical order) is showed in Table 2. Some indicators are of the type “the more, the better”, and they have indicated with the symbol “+” in Table 2. Conversely, some indicators are of the type “the less, the better”, and they have pointed out with the sign “-“ in Table 2.

TABLE II.MATRIX WITH THE VALUES FOR EACH STANDARDIZATION INDICATOR

Country	Indicator										
	ISO-Memb	ISO-Sec.	ISO-Ball.	IEC-Memb.	IEC-Sec.	IEC-Prop.	Act-Std	9001-Price	Leg-STD	9001-Cert	Accred.
Bolivia	11,2	0,0	0,0	0,0	0,0	0,0	3.000,0	24,3	6,0	242,0	0,0
China	683,6	72,0	0,0	182,0	9,0	37,0	37.215,0	153,0	3.470,0	350.631,0	4,2
Colombia	119,0	2,0	1,0	7,8	0,0	0,0	6.054,0	24,5	429,0	2.269,0	5,6
Costa Rica	32,8	0,0	2,0	0,0	0,0	0,0	1.550,0	40,0	160,0	31,0	4,0
Dominican Republic	5,0	0,0	8,0	0,0	0,0	0,0	786,0	51,0	600,0	11.933,0	0,0
Japan	664,0	76,0	0,0	181,2	26,0	26,0	10.587,0	47,5	7.529,0	49.429,0	5,8
Republic of Korea,	633,8	21,0	0,1	160,4	9,0	16,0	20.282,0	144,0	3.072,0	11.378,0	4,2
Spain	544,2	5,0	0,1	154,6	2,0	0,0	32.475,0	110,0	8.600,0	34.438,0	7,4
USA	580,6	108,0	0,0	170,0	25,0	6,0	83.635,0	162,0	17.370,0	30.474,0	6,2

Next, the elements of the matrix must be normalized in order to make them commensurable. This step can be done by applying the normalization method explained in [16]. Using this normalization system, the standardization indicators chosen have no dimension and are bounded between 0 and 1. For our case study, the normalized indicator matrix is shown in Table 3, where the ideal values for each indicator are showed under bold characters, and the anti-ideal values for each indicator are indicated in italics.

TABLE III.MATRIX WITH THE NORMALIZED VALUES FOR EACH STANDARDIZATION INDICATOR

Country	Indicator										
	ISO-Memb	ISO-Sec.	ISO-Ball.	IEC-Memb	IEC-Sec.	IEC-Prop.	Act-Std	9001-Price	Leg-STD	9001-Cert	Accred.
Bolivia	0,009	0,000	1,000	0,000	0,000	0,000	0,027	1,000	0,000	0,001	0,000
China	1,000	0,667	1,000	1,000	0,346	1,000	0,440	0,065	0,199	1,000	0,571
Colombia	0,168	0,019	0,875	0,043	0,000	0,000	0,064	0,999	0,024	0,006	0,755
Costa Rica	0,041	0,000	0,750	0,000	0,000	0,000	0,009	0,886	0,009	0,000	0,543
Dominican Republic	0,000	0,000	0,000	0,000	0,000	0,000	0,000	0,806	0,034	0,034	0,000
Japan	0,971	0,704	1,000	0,996	1,000	0,703	0,118	0,832	0,433	0,141	0,788
, Republic of Korea	0,927	0,194	0,988	0,881	0,346	0,432	0,235	0,131	0,177	0,032	0,571
Spain	0,795	0,046	0,988	0,849		0,000	0,382	0,378	0,495	0,098	1,000
USA	0,848	1,000	1,000	0,934	0,962	0,162	1,000	0,000	1,000	0,087	0,837

Finally, as explained in [16], different rankings of management alternatives can be obtained by solving the following extended goal programming model [18]:
Achievement function:

$$Min(1-\lambda)D+\lambda\sum_{j=1}^{n}\alpha_j n_j \quad (1)$$

Goals and constraints:

$$\sum_{i=1}^{m}\overline{IM}_{ij}X_i + n_j - p_j = \bar{I}_j \quad \forall j \quad (2)$$

$$\sum_{i=1}^{m}X_i = 1 \quad (3)$$

$$\alpha_j n_j - D \le 0 \quad (4)$$

$$X_i \in \{0,1\};\ n_j \ge 0;\ p_j \ge 0 \quad (5)$$

where λ is a control parameter, *D* denotes the maximum deviation; *αj* denotes the weight attached to the *j*th indicator (the same for each indicator in our case study); *IM ij* is the normalized value of the *j*th standardization indicator in the ith country; is the normalized value of the target corresponding to the *j*th indicator; *nj* and *pj* are the negative and positive deviation variables, respectively; and *Xi* represents the decision variables. For this case study, the targets were set by the authors, who considered an achievement of 70% of the ideal value to be an acceptable degree of standardization for all the indicators. This figure has been adopted in [16] and [19].
Thus, for the *j*th indicator, equation (2) expresses the sum of the contributions of all countries to the achievement of the corresponding target, while equations (3) and (5) indicate that only one country can be chosen, given that decision variables *X*i are binary, i.e., *Xi* = 1 if the *i*-th management alternative is chosen, and *Xi* = 0 otherwise.

Finally, equation (1) is the so-called achievement function. It should be noted that due to the normalization implemented, the achievement of the standardization indicators in all the countries is of the type “the more, the better”. Thus, deviation variables *nj*, measuring the under-achievement with respect to the normalized target *tj*, are the only unwanted deviation variables to be included in the achievement function of the model.

By varying the values assigned to parameter λ , Model (1)-(5) provides different solutions. For λ=0 , achievement function (1) becomes *MinD* , and the model provides the solution corresponding to the “most balanced achievement”, i.e., the best management alternative in terms of a balance between the achievement levels reached by the different indicators. On the contrary, for λ=1, the achievement function

becomes $Min \sum_{j=1} \alpha_j n_j$, and the model seeks the alternative with the maximum aggregated achievement in the indicators considered. Both solutions have included in the next Section for our case study.

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III. RESULTS

Table 4 shows the rankings of the countries chosen obtained by iteratively solving Models (1)-(5) for (Ranking A), and (Ranking B), when the same weight was given to all standardization indicators. In the Ranking A, each solution successively represents the country with the best aggregated achievement in the indicators considered, i.e., the most efficient solution. On the other hand, in the Ranking B, each solution is successively the most balanced alternative with respect to the achievement levels attained by the indicators, i.e., the most balanced solution.

TABLE IV.RANKINGS OF THE COUNTRIES IN TERMS OF STANDARDIZATION

Ranking A	Ranking B
China	Japan
Japan	China
USA	Republic of Korea
Spain	Bolivia, Colombia, Costa Rica, Dominican Republic, Spain, USA
Republic of Korea	
Colombia	
Costa Rica	
Bolivia	
Dominican Republic	

For the ranking which shows the best aggregated achievement (Ranking A), China is the country more standardized, following by Japan and USA. However, following Ranking B (the most balanced solution), the best country considered in terms of standardization is Japan, followed by China and Korea. The rest of the countries have the same solution (the ranking does not differentiate among these countries).

IV.DISCUSSION

In this manuscript, we proposed a procedure to obtain diverse rankings of countries in terms of standardization. Here we assumed the same preferential weight for each standardization indicator. However, in many real situations some experts may assign different weights, so causing changes in the rankings obtained. These weights could be established in different ways, usually by direct interaction with a panel of experts. Given that no exercise was done to derive another set of weights for the case study, other possibility could be a sensitivity analysis by successively modifying the weights assigned to the indicators in order to show the changes triggered in the previous solutions. Besides, in the interaction with the experts or stakeholders, the value assigned to the target should be asked. These are an example of future research starting from the model showed above.

The results are consistent with the general perception of the importance of standardization given in the countries analysed, but the indicator devoted to the number of companies certified under ISO 9001 is responsible for boosting China to the first places, as the number of reported certificates in China is more than ten times higher than in the next country. This difference is smaller in the normalized values shown in Table 3, but still significant. Probably, a most suitable indicator would be the number of certificates divided by the amount of companies in a country, i.e. the percentage of companies using standards in their process.
The number of countries used for this study was quite limited and we plan to extend the study to other countries from different regions, e.g. Africa, which is not included in this study. We also would like to include more European countries, but we foresee that at least some indicators will be similar in most of the European countries, because the regional standards have to be equally adopted in all of them and most of the standards are referred in European legislation.
For this paper, we choose indicators with available data that could have a meaning by themselves, but we expect that the overall index have a wider and sounder meaning than any of the indicators taken on its own. Nevertheless, a deeper study on the correlation of those indicators with the known impacts of standards would be desirable, as well as a study on the potential correlation of the chosen indicators.
The limitations found on the meaning given to the indicators chosen are described in the following paragraphs. Starting by the number of standards in a national catalogue as indicator of availability, it has a limited significance, because there are companies providing global access to standards from many countries (E.g. IHS Market, SAI Global, etc.) and therefore the countries have fewer incentives to develop and publish standards.
The prize of ISO 9001 does not properly show how easy is to have legal access to standards for two reasons. The first one is because some countries have a distribution policy which provides easy access to standards in different ways, e.g. free standards to students and civil-servants, wide distribution in many public libraries, cheap collections of standards for professional associations, etc.
The other reason is because the countries have different purchasing power parity and it should be considered in this indicator. The fact that ISO 9001 is sold six times cheaper in Bolivia than in USA

does not necessarily mean that is easier to buy it. For further developments we strongly recommend to divide the price by purchasing power parity.
The data from the ISO Survey of Management System Standards Certification has its own limitations, for the following reasons:

The variability in numbers of certificates reported each year by individual certification bodies.

Inconsistent participation of some certification bodies that contribute to the survey one year but not the next.

The participation of new certification bodies.

It can be argued the significance of accreditation indicator, as the number of accreditation schemes based on standards is very limited. We consider that this limitation is mitigated by the different levels of multilateral agreement existing at IAF. A sensitivity analysis changing the weights given to each level and each organization, or alternatively, a more extensive survey to experts on those weights, would desirable on a future research.

V.CONCLUSIONS

In this paper we show that a composite index can be constructed using a goal programming methodology with the indicators proposed, providing reasonable results. This demonstrates that, though each indicator by itself does not have a strong meaning, the combination of some indicators can be used to obtain a ranking with the level of standardization in different countries.
The index comprises indicators about three big meanings; the resources devoted to standardization, the availability and the use of standards, in each country. The methodology proposed permits the easy incorporation of different preferential weights and other indicators, e.g. related to innovation or education.
The indicators used do not consider the different sizes of the countries, but this consideration would probably change some of the results. We suggest using the price of standards together with the purchasing power parity and the percentage of companies certified, rather than the raw number of companies. The percentage of standards referred in legislation could also replace the number of standards in legislation. We also recommend performing a sensitive analysis on the indicators.
The results show that standardization has a big importance in Asian countries, which is consistent with the known data from other sources, e.g. the training efforts on education about standardization in Asian countries and with the number of standards led by those countries.

SARS Standards

1.STC 1 -Food and Agriculture Products	SARS 0006:2017 SAARC Standards on Biscuits - Specification;2017
2.STC 1 -Food and Agriculture Products	SARS 0007:2017 SAARC Standards on Refined Sugar- Specification;2017
3.STC 1 -Food and Agriculture Products	SARS 0008:2017 SAARC Standards on Code of Hygienic practice for Dairy Industry. 2017
4.STC 1 -Food and Agriculture Products	SARS 0014 Food Hygiene- general principles- code of practice 2018
5.STC 3-Building Materials	SARS/ISO 8491:1998 - Metallic materials -- Tube (in full section) -- Bend test (adoption from ISO) 2018
6.STC 3-Building Materials	SARS/ISO 6892-1:2016 - Metallic materials -- Tensile testing -- Part 1Method of test at room temperature (adoption from ISO) 2018
7.STC 3-Building Materials	SARS/ISO 6892-2:2011 - Metallic materials -- Tensile testing -- Part 2 Method of test at elevated temperature (adoption from ISO) 2018
8.STC 3-Building Materials	SARS/ISO 8492:2013 - Metallic materials -- Tube -- Flattening test(adoption from ISO) 2018
9.STC 3-Building Materials	SARS/ISO 7438:2016 - Metallic materials -- Bend test (adoption from ISO) 2018

BTS Standards

1.BTS 34: 2017 Power Tillers- Basic Requirements (Part 1)
2.BTS: 35: 2018 Power Tiller Test Code
3.BTS: 36: 2018 Power Reaper - Basic Requirements (Part 1)
4.BTS 37: 2018-Walk Behind Power Reaper – Test Code (Part 2)
5.BTS 44: 2018 - Bhutan Standard for raw 'Brag-zhun' and processed 'Brag-zhun' paste
6.BTS 45: 2018 - Bhutan Healthcare Standard for Quality Assurance
7.BTS 53:2017 IEC 60095-1:2006 Lead- acid starter batteries-Part 1: General requirements and method of test
8.BTS 54:2017 IEC 60095-2:2009 Lead-acid starter batteries-Pat 2:Dimension of batteries and dimensions and marking of terminals
9.BTS 55:2017 IEC 60095-4:2008 Lead-acid batteries – Part 4: Dimension of batteries for heavy vehicles
10.BTS 56:2018 IEC 60601-1-2:2014 Medical electrical equipment - Part 1-2: General requirements for basic safety and essential performance - Collateral Standard: Electromagnetic disturbances - Requirements and tests
11.BTS 57:2018 IEC 60601-1-3:2008(Including amd.1) Medical electrical equipment - Part 1-3: General requirements for basic safety and essential performance - Collateral Standard: Radiation protection in diagnostic X-ray equipment
12.BTS 58:2018 IEC 60601-1-8:2006(Including amd. 1) Medical electrical equipment - Part 1-8: General requirements for basic safety and essential performance - Collateral Standard: General requirements, tests and guidance for alarm systems in medical electrical equipment and medical electrical systems
13.BTS 59:2018 IEC 60601-1-11:2015 Medical electrical equipment – Part 1-11: General requirements for basic safety and essential performance – Collateral Standard: Requirements for medical electrical equipment and medical electrical systems used in the home healthcare environment
14.BTS 60:2018 IEC 60601-1-12:2014 Medical electrical equipment - Part 1-12: General requirements for basic safety and essential performance - Collateral Standard: Requirements for medical electrical equipment and medical electrical systems intended for use in the emergency medical services environment
15.BTS 61:2018 IEC 60601-2-1:2009(Including amd.1) Medical electrical equipment - Part 2-1: Particular requirements for the basic safety and essential performance of electron accelerators in the range 1 MeV to 50 MeV
16.BTS 62:2018 IEC 60601-2-2:2017 Medical electrical equipment - Part 2-2: Particular requirements for the basic safety and essential performance of high frequency surgical equipment and high frequency surgical accessories
17.BTS 63:2018 IEC 60601-2-3:2012(Including amd.1) Medical electrical equipment - Part 2-3: Particular requirements for the basic safety and essential performance of short-wave therapy equipment
18.BTS 64:2018 IEC 60601-2-4:2010 Medical electrical equipment - Part 2-4: Particular requirements for the basic safety and essential performance of cardiac defibrillators
19.BTS 65: 2018 IEC 60601-2-5:2009 Medical electrical equipment - Part 2-5: Particular requirements for the basic safety and essential performance of ultrasonic physiotherapy equipment
20.BTS 66:2018 IEC 60601-2-6:2012(Including amd.1) Medical electrical equipment - Part 2-6: Particular requirements for the basic safety and essential performance of microwave therapy equipment
21.BTS 67:2018 IEC 60601-2-8:2010(Including amd.1) Medical electrical equipment - Part 2-8: Particular requirements for the basic safety and essential performance of therapeutic X-ray equipment operating in the range 10 kV to 1 MV
22.BTS 68:2018 IEC 60601-2-10:2012(including amd.1) Medical electrical equipment - Part 2-10: Particular requirements for the basic safety and essential performance of nerve and muscle stimulators
23.BTS 69:2018 IEC 60601-2-11:2013 Medical electrical equipment - Part 2-11: Particular requirements for the basic safety and essential performance of gamma beam therapy equipment

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