



Methodology and Lessons Learned from a Regional Demand Survey in Metrology

A Cooperation between the South Asian Association for Regional Cooperation and the Physikalisch-Technische Bundesanstalt in the field of quality infrastructure

1.	Introduction	3
2.	Demand surveys in metrology: General considerations and methodology	4
	2.1. Stakeholders and objectives from an NMI's perspective	4
	2.2. Steps for the implementation of a demand survey on metrology	4
	2.3. Recommendations for the design of questionnaires	8
	2.4. Data analysis	8
	2.5. Using demand surveys for strategic planning	11
3.	Project context: SAARC-PTB cooperation in quality infrastructure	13
	3.1. Background and rationale	13
	3.2. Project-related activities	14
	3.3. Methodologies applied by the participating NMIs	14
	3.4. Data analysis	15
	3.5. Results	16
	3.6. Decisions taken by the participating NMIs	18
	3.7. Action plan for joint and individual training activities supported by NPL India	18
4.	Summary and lessons learnt	19
	Annex 1: Demand Survey Questionnaire for Services in Metrology – Laboratories	22
	Annex 2: Demand Survey Questionnaire for Services in Metrology – Industry	26
	Abbreviations	32
	Notes	34
	Imprint	36

On behalf of



Federal Ministry
for Economic Cooperation
and Development

On behalf of the Federal Government of Germany, the Physikalisch-Technische Bundesanstalt promotes the improvement of the framework conditions for economic, social and environmentally friendly action and thus supports the development of quality infrastructure.



Authors:

Anett Matbadal, Dr. Vijay Chitnis, Uwe Miesner

1. Introduction

Every economy is unique in size, structure, and versatility. Just as the economic landscape of a country is specific, the demand for the services to be provided by local, regional, or national quality infrastructure (QI) institutions is also unique. The lack of a proper quality infrastructure that sufficiently meets the local demand in its various components, such as standardization, metrology, conformity assessment, and accreditation, is still an issue in a large number of countries. This results in limited access to regional and international markets due to the non-competitiveness of locally manufactured products and technical barriers to trade. Local businesses must have access to basic quality infrastructure services in order to be competitive and sustainable.

Therefore, knowing the current and future needs of industry and other sectors is key for a country's economic development and the welfare of its society. Furthermore, this information can be used to increase the competitiveness of local products and to establish the necessary capabilities in the respective QI institutions. This applies in particular to a country's national metrology institute (NMI) or an equivalent institution responsible for the uniformity of the metrological aspects of daily life. A commonly used tool to gather information on the needs of an NMI's stakeholders are demand surveys. Although there is no blueprint on how to conduct a demand survey, lessons learnt and good practices exist which may guide NMIs in this endeavour.

Regional cooperation among NMIs can effectively support the implementation of demand surveys, particularly with regard to follow-up activities, as once the demand for metrological services is known, it is equally important to seek ways to close the identified gaps. Regional cooperation is of great importance in this regard, as resources are usually limited and may not be allocated in line with the increasing demand. In the longer term, the specific metrological needs can only be met through cooperation amongst NMIs to the necessary extent and in a cost-effective way.

Against this background, this document, prepared within the framework of PTB's cooperation with the South Asian Association for Regional Cooperation (SAARC) funded by the Federal Ministry for Economic Cooperation and Development (BMZ), has the following objectives: First, it provides guidance on the methodology that can be applied to conduct a regionally coordinated demand survey on metrology. Second, it shows how regional cooperation can be used to effectively support demand surveys by using regional expertise and networking. Third, it summarizes the results, good practices, and lessons learnt during a pilot exercise conducted by four SAARC countries, namely Bangladesh, Bhutan, Sri Lanka, and Nepal.

In pursuit of these objectives, Chapter 2 explains the general approach to demand surveys in metrology. Chapter 3 describes the project-related activities that were conducted to guide the pilot exercise and the various approaches taken by the participating NMIs of the SAARC countries to obtain conclusive results. In Chapter 4, the lessons learnt from the applied methodologies are summarized. These are enhanced by incorporating the lessons learnt and experience gained from demand surveys conducted in other PTB projects.

Last, it should be noted that the methodology described in this document can be applied for similar surveys on metrological needs in other regions, in particular in heterogeneous regions, and also adapted to any demand survey in other areas of QI. However, although the general approach can be applied to any region, the individual demand analyses and approaches taken may vary from economy to economy.

2. Demand Surveys in Metrology: General Considerations and Methodology

2.1. Stakeholders and objectives from an NMI's perspective

The national metrology institute (NMI) of a country or an equivalent establishment is the key institution of a country's measurement system. The main task of the NMIs is to ensure the traceability to all other calibration, testing, and industrial laboratories as well as industrial and commercial measurements taking place in the country. More specifically, measurement services which are usually provided by the NMI comprise calibration, testing, and verification as well as training and consulting services related to metrology.

Demand surveys aim to address the needs of stakeholders. Stakeholders of an NMI include the following, amongst others:

- Manufacturing companies in the various sectors of industry
- Calibration and testing laboratories
- Legal metrology laboratories and offices (if separate from the NMI)
- Other NMIs
- Health institutions (hospitals and practices)
- Agro-processors
- Scientific research institutions
- Environmental monitoring authorities
- Educational institutions

The objective of needs assessments in metrology is to gather at least the following information relevant to the NMI:

- Which areas of metrology are the most relevant to stakeholders or the target groups?
- Which equipment in use in the country needs calibration and/or verification?

- Which ranges need to be covered for calibrations in the specific areas and for the various types of instruments?
- Which training and consulting services do local clients need?
- Additional useful information: Which export markets (and, in turn, which foreign regulations and standards) are the most important or relevant?

Depending on the available resources, the NMI is then tasked with upgrading and expanding the scope of its services according to these needs. Ideally, the survey will also gather information on the future demand, allowing the NMI to predict the demand situation in ten years regarding the types of measuring instruments that will be used in industry, science, and other sectors, as well as the ranges and levels of accuracy that will be required.

2.2. Steps for the implementation of a demand survey on metrology

A demand survey, irrespective of the subject, always comes with challenges and requires thorough preparation in order to achieve the intended outcome. Phase 1 – *preparation* – is the key phase. It determines how successful phase 2 – *implementation* – will be and how effectively phase 3 – *evaluation and follow-up* – can be executed.

The following overview outlines the aspects which need to be taken into account when planning and conducting a needs assessment in metrology. It gives specific recommendations on how to carry out the various steps and points out opportunities for regional cooperation, wherever possible.

Each and every phase is important. However, as mentioned above, the most critical stage is the preparation phase, during which the target group and sample size are chosen and data and information which are already available or can be gained from accessible sources (local ministries, industry associations, trade portals, etc.) are col-

lected. Thorough preparation reduces the efforts which will need to be invested to send out questionnaires or conduct interviews. It has proven effective to form teams which are responsible for analysing and addressing specific areas such as specific target groups or sectors.

Phase 1: Preparation	
Defining the objectives of the survey	
The reasons why a demand survey is needed as well as the respective objectives can be manifold. However, the objectives determine which approach should be taken, including whether specific sectors are to be targeted or the survey should cover all economic sectors, i.e., the whole spectrum of potential clients. The defined objectives also help to determine which questions need to be included in the survey and how the results would need to be analysed.	
Pre-analysis of the available demand information	
Determine whether a demand survey on metrology has already been conducted in the country. If so, collate existing data as required and collect all information that is available from other sources.	
<p>Demand surveys have been carried out in other countries and regions before. Try to gain access to information from other NMIs. A cement factory in one country/region may not be so different from a cement factory in another one. Use your contact channels to other NMIs in the region and beyond. This can save time and resources!</p> <p>Demand information can also be derived from calibrations which were performed for clients in recent years. These include the services provided to calibration and testing labs as well as to legal metrology authorities. The calibrated instruments can be categorized by the various metrological areas (mass, pressure, temperature, etc.) and should include the following:</p> <ol style="list-style-type: none"> 1. Number of instruments calibrated per area (period: last three years) 2. Breakdown of types of instruments, overall ranges, accuracies, etc. 3. List out the additional requirements of the stakeholders 	<p>Regional approach Existing knowledge about the demand in certain sectors (i.e., the cement industry, agro-processing, and the beverage industry) should be <i>shared</i>!</p>
Desk study – Analysis of the country's economic landscape	
If no data are available at all or a new approach is needed, a desk study is recommended.	
<p>The desk study should include at least the following points:</p> <ul style="list-style-type: none"> • The main economic sectors relevant for the country's gross domestic product (GDP) • The top 20 (or 100) enterprises • The estimated number of enterprises per branch <p>The involvement of industry/business associations or chambers of the various sectors can be very valuable. They can provide information about the sector in general, the specifics, name the <i>big players</i>, etc. They can also give advice on how to approach specific companies.</p>	
Selecting target groups	
<p>Depending on the objective(s) of the demand survey and the available resources, it may cover the entire economic spectrum or only specific sectors.</p> <p>Possible criteria for the selection of the target group:</p> <ul style="list-style-type: none"> • Core economic sectors (share in GDP), including new emerging sectors with great development potential in the country • Top 20 (or 100) enterprises by branch • Export figures per branch/commodity • Number of calibrations performed for clients in individual economic branches (in recent years), etc. <p>This information can be sourced online or gained from business chambers/associations, the ministries of industry and commerce, other ministries, etc.</p>	<p>Regional approach Share the work!</p> <p>It is possible to focus on one sector in one country and on others in other countries. Since the needs per sector would be similar, only the number of enterprises per sector may vary.</p> <p>For a regional demand survey, it can be very useful to conduct an opening workshop. There, the specific approaches and methods for conducting the survey and analyzing as well as sharing the results can be agreed upon.</p>

Collecting contact addresses of companies and laboratories to be surveyed and preparing contact lists

To ensure that the results of the survey will be useful, it is crucial to involve the *right* person(s) at the enterprises for the survey. The questionnaire should be sent to a person who has good technical knowledge and an overview of the measurements being taken at the company and the measurement instruments used. If interviews are being conducted, they should be arranged with this specific person. An introduction letter/e-mail announcing the survey could be sent to the CEO or the managing director of the company to find out who to approach and request as the interview partner or respondent to the questionnaire.

Deciding on the type of survey (questionnaire and/or interview) and sample size

The number of surveyed enterprises per branch or sector should be *representative*, i.e., the sample size should reflect the importance of this branch/sector with regard to the specific objective of the survey and/or the number of enterprises operating in the sector (e.g., a percentage of the respective share).

This decision should also take the available information on measurement demand and the available resources into consideration. Dual approaches, i.e., in which questionnaires are sent out *and* interviews are conducted, have proven effective and successful.

Note: Conducting interviews takes time and ties up resources. However, face-to-face contact is very important and more valuable than surveys conducted by mail/e-mail only. If this survey represents the first active contact of the NMI with a specific company, a face-to-face interview may be the better option, as it has additional advantages. Besides collecting demand information, it also represents a very good opportunity to market the services of the NMI to a potential client.

Preparing the questionnaire and/or interview checklists

It is advisable to use customized questionnaires for these respondents:

1. Calibration/testing laboratories and verification offices
2. Companies/enterprises (industry, agro-sector, etc.)

Questionnaires can be designed in multiple ways. Depending on the available capacities, they may be developed as a WORD document, an EXCEL table, or in a fully digital format through a web tool. The higher the degree of digitalization, the easier it will be to compile the received feedback.

The interview checklist (face-to-face contact) and the questionnaire (sent by mail) could be identical. However, when conducting an interview, additional information can be gathered. Some criteria for questionnaires are provided in Section 2.3.

Regional approach

Depending on the focus of the survey used by the participating NMIs, a regionally harmonized questionnaire could be jointly prepared and used.

Phase 2: Implementation**Sending out survey questionnaires to the selected enterprises/laboratories**

(if questionnaires were selected for the survey)

The distribution of questionnaires could be realized in the following ways:

- Sending them by mail or electronically (by e-mail)
- Advertising on the NMI's website
- Handing them over personally during regular contact with clients, e.g., in connection with calibration work
- Advertising in the newspaper

Continuous follow-up with the recipients of questionnaires

Follow-up by telephone and/or e-mail may be necessary. It has proven successful to assign one assistant staff member to this task for a defined period of time.

Training interviewers (if necessary)

Depending on the planned number of interviews, it might be necessary to involve external persons to carry out the interviews. Preferably, the interviews should be conducted by metrologists since they understand the matter best. However, external persons could be involved, provided that they receive proper training. They should be made familiar with the questions, why these questions are important, and know which information is desirable. It has proven quite effective to include the trainees in a number of real interviews so they can witness the process and to learn about the context.

Contacting laboratories and enterprises using the contact lists and arranging appointments for the interviews

This work could be carried out by assistant staff. Again, an introduction letter that announces and explains the survey could increase the willingness of clients to respond.

Collating the received feedback

Sufficient resources are needed to analyse the received feedback (from survey questionnaires, interview protocols, etc.) and to collate the information in a way which will allow valuable conclusions to be drawn (see Chapter 2.4).

Phase 3: Evaluation and follow-up	
Analysis and evaluation of results	
<p>Depending on how the questionnaire is designed, the analysis of the results will need to be done manually or can be partially or even fully automated.</p> <p>The analysis should also include the consideration of future short- and medium-term developments in the country (emerging industries), if possible. Information could be gathered from other NMIs in countries where these industries are already established.</p> <p>The <i>output</i> of the survey should reflect the objectives, but would normally include the following at the very least:</p> <ul style="list-style-type: none"> • A list of the major companies and laboratories (in the target sectors) with contact data and other relevant information (as defined beforehand) • A list of instruments categorized by the various metrological areas (mass, pressure, temperature, etc.) that need calibration and includes this information: <ul style="list-style-type: none"> – The number of instruments used per metrological area (a rough number is sufficient) – A breakdown of types of instruments, ranges, accuracies, etc. (the overall measurement ranges by instrument type should be worked out) • The identified demand for training and consultancies in metrological aspects • The communicated demand for other services (e.g., PT provision) 	<p>Regional approach</p> <p>If efforts were shared regionally (e.g., targeting different sectors in different countries), the results should be shared regionally and jointly discussed as well.</p>
Determining and analysing the gaps between the current services and the identified demand	
<p>The feedback of the survey regarding equipment that needs calibration or verification should be clustered to be able to identify areas where high numbers of instruments are in use and areas with critical importance for human health and safety. The current capabilities of the NMI can then be compared to the identified customer needs and prioritized. The analysis should also identify gaps that can be closed relatively easily (identify <i>low hanging fruits</i>).</p>	
Identifying the necessary actions	
<p>The necessary actions could be the following (see Chapter 2.4):</p> <ul style="list-style-type: none"> • <i>Further development</i> of the existing calibration capabilities – inclusion of objectives in the development plan (short and medium term) • <i>Building up capacities</i> in new areas of metrology (medium and long term) • Entering into <i>regional cooperation</i> partnerships in specific areas of metrology. (Not every NMI can build up competence in all necessary fields. Regional cooperation is a great option!) • <i>Developing a strategy</i> on metrology which addresses the identified demand <p>Note: The results may have implications on existing strategies!</p>	<p>Regional approach</p> <p>The development of a joint action plan can enable the use of synergies and effectively address the development of the necessary capacities at individual NMIs and, where possible, the establishment of regional reference laboratories.</p>



2.3. Recommendations for the design of questionnaires

Hardly anyone enjoys filling out questionnaires. Therefore, it is very important to approach the targeted recipients in a smart way which includes explaining the reasons for the survey and how their institutions will benefit from participation. A cover letter that accompanies the questionnaire, or that is sent ahead of it, is of critical importance for the success of the survey.

As regards to the survey, the questions and the way they are asked are of similar importance. They not only influence the response rate, but also influence the validity and reliability of the response data. Additionally, questionnaires must be easy to fill in and, ideally, fully digitalized. It is, however, good to provide an alternative, i.e., the recipient can choose whether he/she would like to answer the questions in written form or electronically.

- These are some *rules* for preparing questionnaires:
- Make all questions clear and simple.
 - Don't ask hypothetical questions.
 - Make sure the context is clear.
 - Your response options must address all possible answers.
 - Make sure to value your respondents' time and only ask relevant questions.
 - Make questions neutral to avoid biased answers.
 - Every question must be essential (too many questions → fewer answers).

2.4. Data analysis

Processing and analysing the collected data and information can be very time-consuming. Therefore, thorough planning of the data processing and analysis stages is the most important part of the survey. Just like the survey methodology, the analysis method can range from manual data entry to fully automated work.

In many cases, an EXCEL spreadsheet is sufficient to process the received information. It should, however, be aligned with the questionnaires to facilitate the analysis.

A section of a simple spreadsheet to facilitate processing the received information from two types of questionnaires is presented below. The information needs to be entered manually for each company/laboratory. Basically, the spreadsheet has two parts. The first one is for general information related to the organization (company/laboratory) as well as the quality management system. The second part is reserved for concrete information about the measurement instruments used at the organization (which instruments need regular calibration, etc.).

In the following, the respective areas of the spreadsheets are shown:

1. a) General contact data

No.	Laboratory / Company (for in-house lab)					Contact Person						
	Lab or Company Name	Adress Field I	Adress Field II	City	Region	Mr / Ms	Title	First Name	Family Name	Position	Phone	Email

Figure 1: General contact information (laboratory/company)

b) Additional information

General Information							Equipment	Participation in Inter-laboratory Comparison or PT?	Were respective needs communicated (yes/no?)			
Type / Lab Area	Lab accredited acc. to ISO/IEC 17025?	Other accreditation (e.g. ISO 15189)?	Services offered to other countries?	Number of Employees	QMS ISO 9001 certified??	QMS ISO 9001 compliant?	List of Equipment provided?		Calibration demand that can not be provided locally?	Inter-laboratory Comparisons or PTs?	Metrology training?	Consultancy services?

Summary of data from Labs:

ISO/IEC 17025 accredited:	Other accreditation:	Services to foreign countries:	No of Employees:	QMS ISO 9001 certified:	QMS ISO 9001 compliant:	Equipment List provided:	Participated in ILC / PT:	Calibration externally needed:	ILCs / PTs needed:	Training needed:	Commsultancy needed:
Yes: 0	Yes: 0	Yes: 0	1-9: 0	Yes: 0	Yes: 0	Yes: 0	Yes: 0	Yes: 0	Yes: 0	Yes: 0	Yes: 0
No: 0	No: 0	No: 0	10-99: 0	No: 0	No: 0	No: 0	No: 0	No: 0	No: 0	No: 0	No: 0
			100-199: 0								
			>200: 0								

Figure 2: Laboratory data (summary of management system and communicated needs)

General Information							Equipment	Were respective needs communicated? (yes/no?)		
Branch	Are products exported?	Number of Employees	QMS implemented?	According to which standard?	In-house laboratory operated?	Was a lab questionnaire filled in?	List of Equipment provided?	Calibration demand that can not be provided locally?	Metrology training?	Consultancy services?

Summary of data from Companies:

Are products exported?	Number of Employees	QMS implemented?	According to which standard?	In-house laboratory operated?	Was a lab questionnaire filled in?	Equipment List provided:	Calibration externally needed:	Training needed:	Commsultancy needed:
Yes: 0	1-9: 0	Yes: 0	ISO 9001: 0	Yes: 0	Yes: 0	Yes: 0	Yes: 0	Yes: 0	Yes: 0
No: 0	10-99: 0	No: 0	ISO 14001: 0	No: 0	No: 0	No: 0	No: 0	No: 0	No: 0
		100-199: 0	HACCP: 0						
		>200: 0	Lab: IEC 17025: 0						
			Other: 0						

Figure 3: Company data (summary of management system and communicated needs)

2. Overview on measuring instruments used

Metrological knowledge is required to analyse the submitted lists of equipment as well as any additional information on equipment provided in the questionnaires or during the interviews. Experience has shown that the quality of the reported data and information on measuring instruments varies. In many cases, the information that is provided is incomplete and sometimes even unus-

able, meaning that it is necessary to follow-up with the organization which submitted it. Each and every equipment list must be carefully analysed, and all received data must be collated. Data entry by hand is a time-consuming task.

The EXCEL spreadsheet can be prepared to categorize the various types of equipment and to sum them up:

Measurement Field	Equipment	Number of Instruments	Range	Resolution d (Readability) / Scale interval (e.g. 0.1 g or 1 mm)
Mass	Balances Analytical balance ($d \cong 0.01 \text{ mg} \dots 0.1 \text{ mg}$) Precision balance ($d \cong 0.1 \text{ mg} \dots 1 \text{ g}$) Industrial/ Trade balance ($d \cong 1 \text{ g} \dots 10 \text{ g}$) <i>Others (please, specify):</i>			
	Total number of balances:	0		
Mass	Weights OIML Class E2 OIML Class F1 OIML Class F2 OIML Class M1 <i>Others (please, specify):</i>		pcs. sets pcs. sets pcs. sets pcs. sets	
	Total number of weights (pieces):	0		
	Total number of weight sets:	0		
Temperature	Liquid-in-glass thermometer Resistance thermometer Digital thermometer Thermocouple <i>Others (please, specify):</i>			
	Total number of thermometers:	0		
Pressure	Pressure gauge / manometer (oil) Pressure gauges / manometer (gas)			

Figure 4: Table summarizing the number of instruments per equipment category

Measurement Field	Number of Instruments
Balances	0
Weights	0 pieces
Weights	0 sets
Temperature	0
Pressure	0
Dimensional	0
Electrical	0
Flow	0
Force	0
Rel. Humidity	0
Moisture	0
Torque	0
Hardness	0
Volume	0
Density	0
pH	0
El. Conductivity	0
Viscosity	0

This summary table shows the total number of instruments in each of the respective metrological fields (quantity).

To assess the existing gaps between the current capabilities of the NMIs and the identified demand, a detailed analysis is needed for each existing and new metrological field in order to identify the various types of measuring instruments and the respective measurement ranges.

2.5. Using demand surveys for strategic planning

As already pointed out, for an NMI to meet the metrological needs of its industry and society, it is essential for it to know what these needs are. There are various ways to investigate the demand for metrological services – a demand survey is only one of them. However, all information that can be gathered about the current and future demand should be carefully analysed and, where possible and necessary, existing strategies should be adapted. A demand survey is also a valuable source of information for the development of a country's medium- to long-term metrology strategy.

If the NMI is still in its development phase and a demand survey is being conducted for the first time, a significant amount of information and data must be collected, processed, and analysed. The results of this analysis may serve as the basis for crucial development decisions of

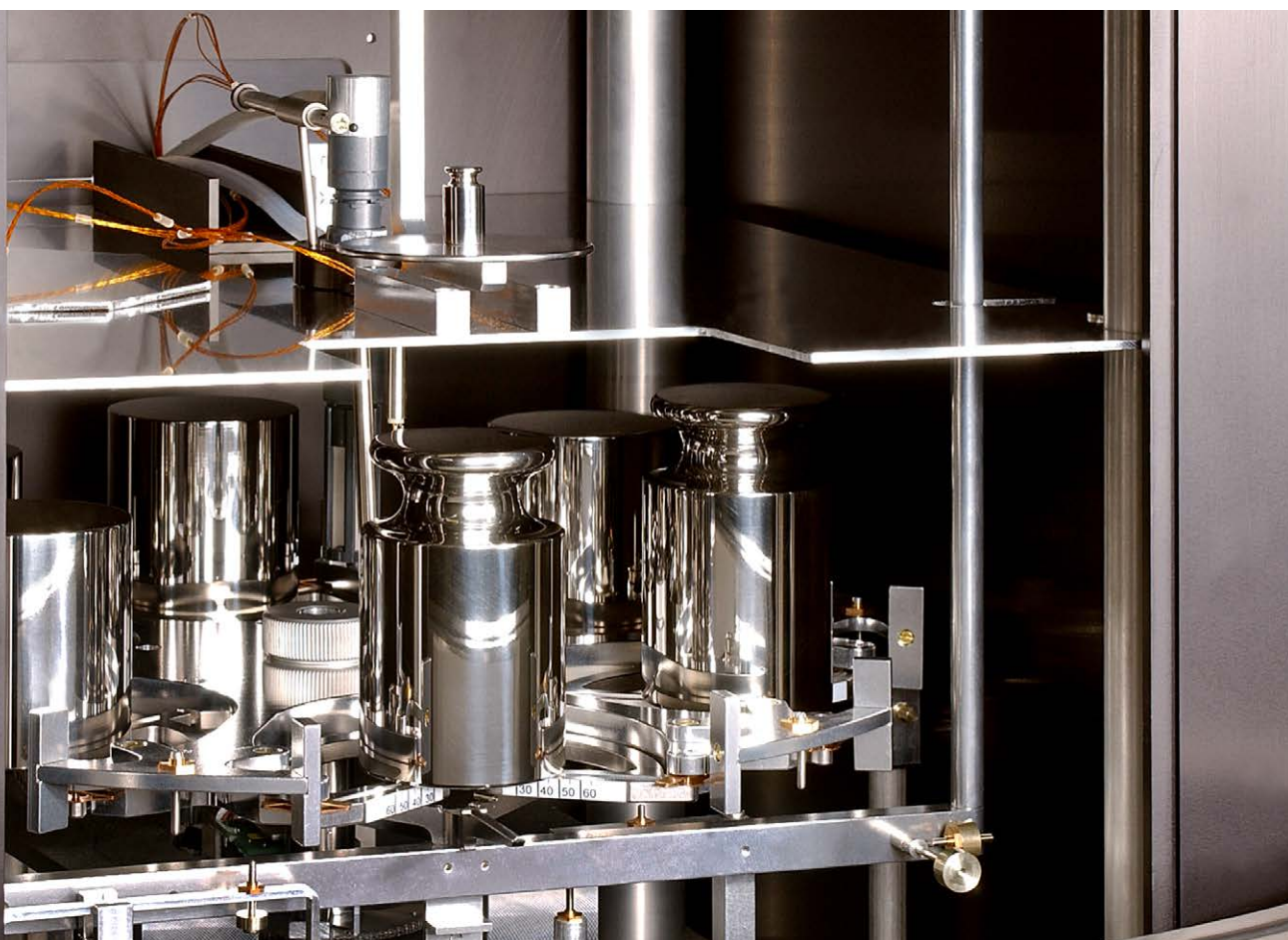
the NMI that may range from the procurement of new standard equipment to the construction of a new laboratory building or to the development of capabilities in new areas. At a later stage, new demand information may lead to scope expansion or minor changes in the strategies.

However, it is important to highlight that as the metrological needs of industry and society change over time as a result of technological developments and changes in cultural and social life, these needs must be continuously monitored, and strategies must be adapted for both industrial and legal metrology. This can be achieved through the systematic and continuous collection of demand information from clients during the normal operations of the NMI, or by repeating a focused demand survey every five to ten years.

Strategic and operative decisions with respect to metrology may include these points:

- Procurement of equipment to expand existing scopes of calibration in specific areas
- Development of capabilities and procurement of equipment to develop new areas
- Expansion of existing laboratory facilities
- Construction of a new laboratory building
- Capacity building for metrological staff in new areas
- Capacity building for newly hired metrological staff
- Pursuit of accreditation in specific areas
- Set up of regular training programmes for stakeholders on metrological matters
- Development of capacities as a PT provider in the longer run
- Development of customer awareness about new facilities (if any) which have been established as a result of the survey

In order to use the received data and information for strategic planning effectively, the selected actions should be prioritized and laid down in an action plan spanning one to three or five years. Furthermore, the action plan should consider the necessary sub-activities, proper timelines, and costs as well as the responsible departments/persons to involve. Established regional mechanisms in metrology should be used as much as possible to address certain actions, in particular when new areas are to be developed. Opportunities for joint projects and the use of regional synergies to ensure the accessibility of local companies to metrological services are worth investigating, in particular in heterogeneous regions. Not every country has the resources to establish capabilities in all metrological fields. However, if capabilities need to be developed, the existing cooperation with peers in the region should be used and the regionally established and available metrological expertise should be tapped into as well.



© PTB/Fotografie

3. Project Context: SAARC-PTB Cooperation in Quality Infrastructure

3.1. Background and rationale

The pilot demand survey exercise was realized within the framework of German development cooperation in which the member countries of the South Asian Association for Regional Cooperation (SAARC) and Physikalisch-Technische Bundesanstalt (PTB) implemented the project entitled *Strengthening regional integration and cooperation in the field of quality infrastructure in SAARC*. At the project planning workshop in Kathmandu in May 2018, the assessment of the needs for calibration and testing services was identified as one of the project's priorities. This assessment was intended to help the participating NMIs to have a solid decision base for the extension of the existing services and development of new areas in metrology. Regional cooperation supported through this project could then be utilized effectively. Pilot demand surveys on the calibration needs of industry, conducted by interested national metrology institutes (NMIs), have therefore been integrated in the project's work plan.

While identifying and assessing demand, as a rule, is a national initiative, the regional cooperation aspect of it was promoted through the project from the very beginning. This refers in particular to sharing survey results and lessons learnt as well as to finding regional solutions to close the identified gaps. The SAARC region is very heterogeneous. This is also true with regard to the level of development of the national institutions responsible for metrology.

Here is a list of the institutions that are tasked with metrology in the SAARC region:

- Afghanistan: Afghanistan National Standardisation Authority (ANSA)
- Bangladesh: National Metrology Laboratory (BSTI-NML)
- Bhutan: Bhutan Standards Bureau (BSB)
- India: National Physical Laboratory (CSIR-NPL)
- Maldives: Maldives Standards & Metrology Unit (MSMU)
- Nepal: Nepal Bureau of Standards and Metrology (NBSM)
- Pakistan: National Physical and Standards Laboratory (NPSL)
- Sri Lanka: Measurement Units, Standards and Services Department (MUSSD)

Interested NMIs were invited to conduct demand surveys at the national level, guided by independent experts. The NMIs of four countries – Bangladesh, Bhutan, Nepal, and Sri Lanka – showed an active interest. For technical support through regional cooperation, the National Physical Laboratory of India was involved as a strong and engaged partner.

3.2. Project-related activities

The pilot exercise was implemented during the 2019–2021 period and was facilitated by two independent experts, Ms Anett Matbadal and Dr Vijay Chitnis, based in Guyana and Delhi, respectively. The provided support covered the following stages:

Introducing the project and providing information

As per the decision taken during the kick-off workshop in May 2018 to conduct an exercise on needs assessment in metrology, the basic approach to be taken by the SAARC NMIs was explained and objectives, possible target groups, and the scope were further clarified. Following this, a guidance document, similar to the one presented in Chapter 2.2, was introduced in which the various phases of the survey were explained.

Collecting baseline information from NMIs

Next, feedback was sought from all NMIs regarding their current state of preparedness. The questionnaire used for this purpose comprised the following:

1. What specific objective(s) are you pursuing with the demand survey?
2. Have you already brainstormed/decided on the target group, sector, or sample size of the survey?
(If yes, please specify.)
3. What type of preparatory activities have you already undertaken? (Please specify, e.g., desk study on industrial sectors, preparation of contact lists and/or questionnaire, etc.)
4. What specific support do you expect from external partners, such as PTB, to implement the survey?
5. Has your institute carried out any demand surveys in metrology in the past? If yes, what was the outcome?

Guidance for survey preparation

Various virtual meetings were held by the experts with the interested NMIs to provide additional support for the preparation of the survey. In particular, the NMIs were assisted in developing the survey questionnaires. Customized sample questionnaires (see annexes) for industrial companies and for calibration/testing laboratories were provided that the NMIs could adapt to their specific needs, if necessary. They were provided in the form of WORD and EXCEL files.

Follow-up during the implementation and analysis phases

During the implementation phase, the NMIs received continuous support from the experts, whenever required. An analysis tool, based on an EXCEL spreadsheet (see Chapter 2.4), was provided for use in processing the received information and data.

Concluding workshop

A face-to-face workshop was initially planned where the individual experiences of the NMIs which conducted the demand survey could be reported to the others. Furthermore, the workshop aimed to jointly work on cooperation concepts to address the identified needs of the NMIs concerning meeting the demands of industry. However, due to the pandemic conditions in the SAARC region, this physical workshop could not be held. Instead, virtual meetings were held in June 2021 at which the participating NMIs shared their experiences with each other as well as with CSIR-NPL (India) and PTB. During the discussions, the participating NMIs prepared action plans which addressed how to develop the capacities of the NMIs to the required levels.

3.3. Methodologies applied by the participating NMIs

During the collection of baseline information, the participating NMIs named a wide range of objectives for the survey, e.g.:

- Understanding the market needs of the country to expand the range of measurement parameters accordingly
- Assessing calibration capabilities and identifying gaps
- Increasing capacity to close the gaps and meet future needs
- Identifying the required level of accuracy of each measurement parameter used in calibration laboratories, testing laboratories, and industries to extend the scope and establish measurement traceability
- Identifying training and consultation requirements for measurement services
- Identifying the proficiency testing requirements of the calibration and testing laboratories

- Developing action/cooperation plans and procurement plans to strengthen the services to be provided
- Developing a strategic plan
- Starting projects to provide services for specially identified sectors, e.g., health, environment, etc.

Based on these objectives, all participating NMIs basically carried out the following steps:

1. Defining the objectives of the demand survey
2. Analysing the available demand information, if any
3. Conducting desk research on the economic landscape and the major players in industry
4. Defining the target groups
5. Collecting the contact data of all companies and laboratories to be included in the survey
6. Preparing questionnaires
7. Sending the questionnaires using multiple distribution channels
8. Collecting feedback from the recipients
9. Following up with the recipients, where necessary
10. Analysing the received data and information
11. Identifying the necessary actions using this data and information
12. Prioritizing the identified actions to cater for the demand.

Using the available information and having conducted additional desk research, the target groups were selected. The most common approach was to target large companies in important sectors and to include calibration and testing laboratories as a separate group.

Important sectors that were selected to be surveyed included the following:

- Cement industry/construction materials
- Agriculture, livestock, and forestry
- Manufacturing
- Garment and textile industry
- Food and beverage industry
- Pharmaceutical industry
- Health institutions
- Power and water supply sector
- Calibration and testing laboratories

All participating NMIs used questionnaires as their survey instrument. Two different questionnaires were recommended for the pilot exercise. They were customized for companies in industry and for calibration/testing laboratories (see annexes). Each of the questionnaires was customized by the participating NMIs to fit their objectives.

Various methods were used to distribute the survey forms. All NMIs used multiple ways, including these:

- Mail
- E-mail
- Personal contact (during on-site calibrations)
- Newspaper advertisements
- Information on websites (downloads)

Additionally, information on the needs of clients regarding metrology was received through the following:

- Suggestions posted on the NMI's website
- Feedback received during stakeholders' visits to the NMIs for calibration jobs
- Feedback received during on-site calibrations

The NMIs could not conduct face-to-face interviews due to the existing pandemic conditions. Under other circumstances, site visits could have been used to conduct additional face-to-face interviews.

3.4. Data analysis

Different strategies were used to analyse the collected data. The piloting NMI's were provided with the EXCEL spreadsheets for industry clients and laboratories that were introduced in Chapter 2.4 of this document. At least one NMI used this EXCEL tool for the analysis stage. All, however, produced some kind of statistics on the reported equipment in use (types and numbers per metrological field) and additional needs (training, proficiency testing, and consultancy).

3.5. Results

Feedback received by the participating NMIs

The follow-up process turned out to be quite lengthy, as according to the participating NMI's, responses from companies and laboratories came in slowly and were scarce. However, the NMIs did a follow-up, mainly by phone. After finalizing the survey activities, response rates of between 40 %-75 % were reported.

In one case, the low response rate was thought to be associated with the NMI not being sufficiently linked with the industrial sector, and specific actions were planned to improve this situation.

The information received from the surveyed companies and laboratories was collated. All NMIs prepared statistics on the calibration needs in the various metrological fields, such as shown in the following chart:

Need analysis

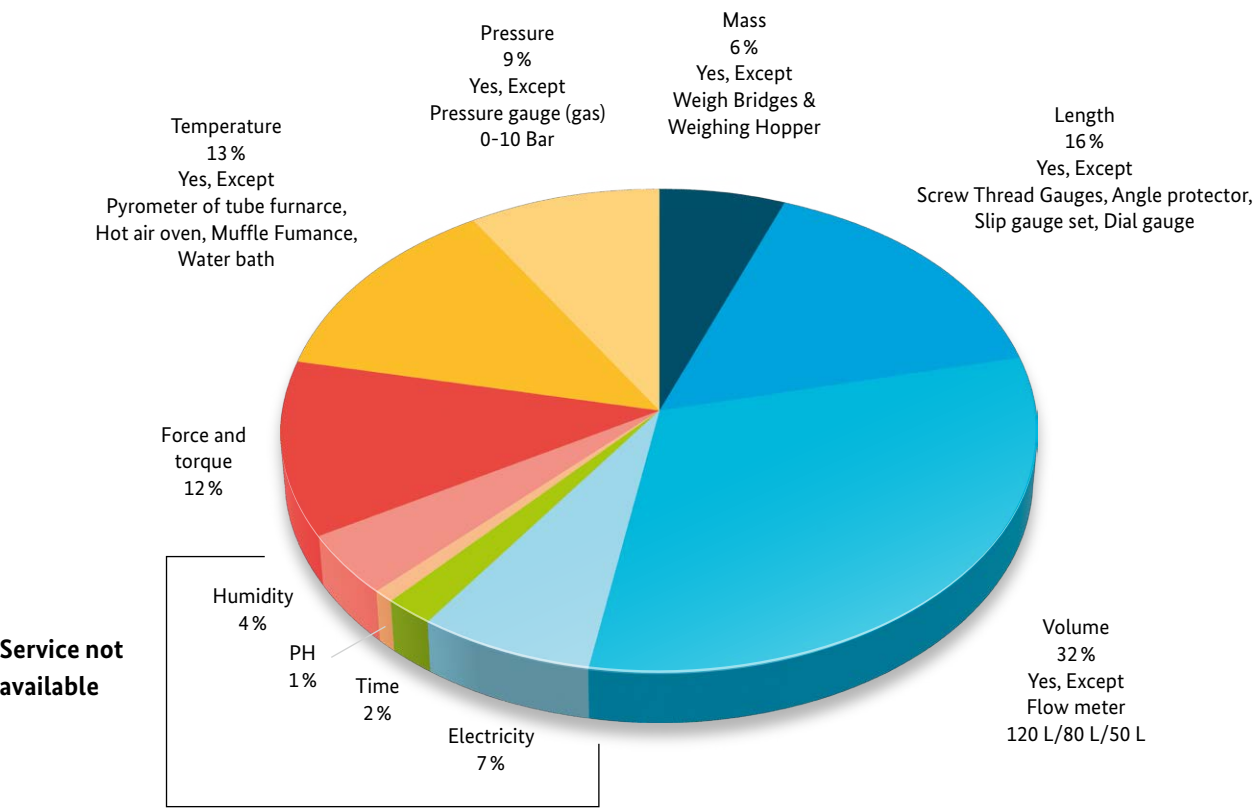


Figure 5: SAARC NMI survey (example): Communicated calibration needs

The NMIs' charts primarily illustrate the areas with the highest demand in terms of the number of instruments to be calibrated. Other statistics show a breakdown by type of instrument per metrological field, e.g., vernier callipers, measuring tapes, dial gauges or screw thread gauges for the dimensional area.

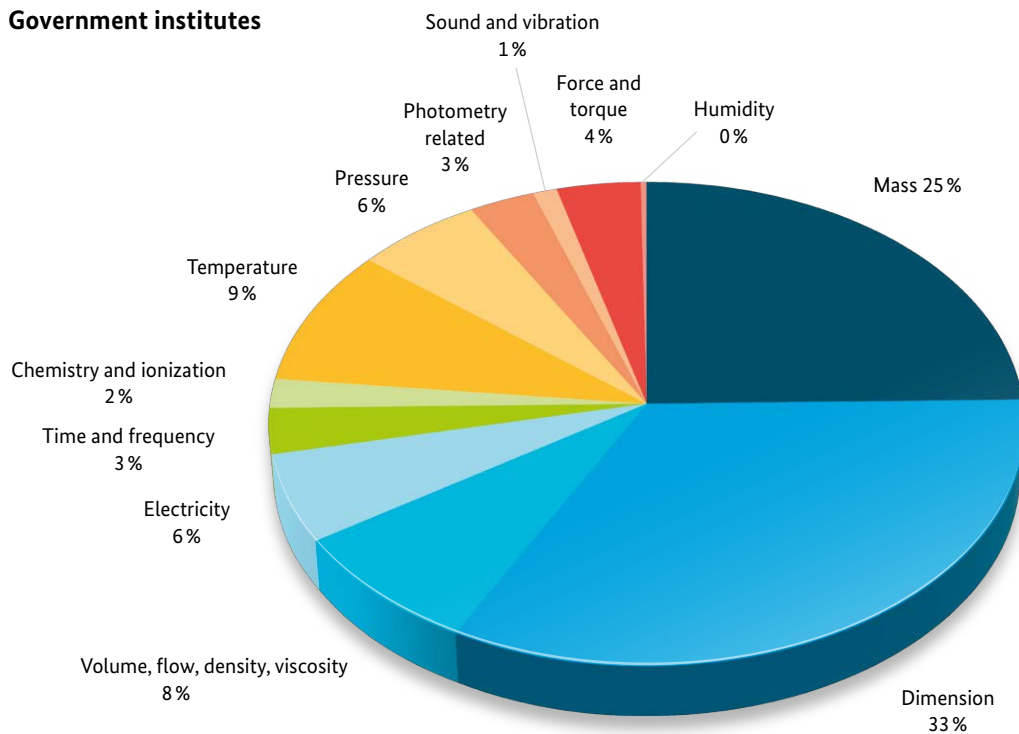
The following areas were identified by all participating NMIs as being of the highest importance:

- Mass
- Volume
- Temperature
- Dimension/length
- Pressure
- Electrical parameters

Additionally, the need for training and consultancy was identified, which included handling and maintenance of measuring instruments, calibration methods, and estimating uncertainty in measurement.

Laboratories also communicated the need for proficiency tests and interlaboratory comparisons.

Government institutes



Industry and testing laboratories

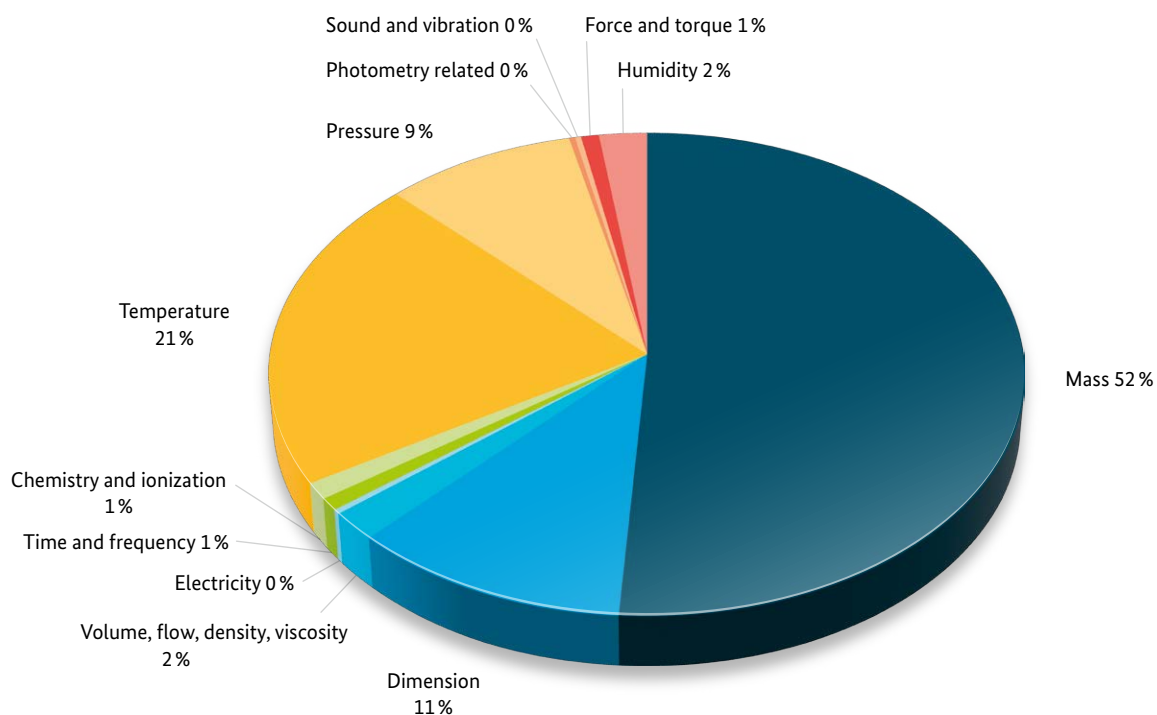


Figure 6: SAARC NMI survey (example): Communicated training and consultancy needs

Identified gaps and challenges

Based on the assessment of the existing gaps between the current capabilities of the NMIs in metrology and the identified demand, the NMIs identified areas where action was needed.

Areas where no metrological services can be provided yet by the NMI included, for example:

- Force
- Torque
- Humidity
- Flow
- Electricity
- Density
- Viscosity
- Photometry

In other areas, the expansion of the current calibration scope was identified as being a priority.

- Procuring equipment for compression/tensile testing machine calibration and providing related capacity building for metrological staff
- Pursuing accreditation in volume
- Development of new capabilities in specific areas:
 - Force calibrations
 - Humidity calibrations
 - Electrical calibrations (AC/DC)
 - Pressure calibrations (up to 10 bar)
 - Chemical metrology
 - Energy meter testing

The additional information that was obtained in these surveys could be used for strategic decisions that have a longer-term strategic focus. Such information received from clients was, for example, that there are not enough calibration laboratories in the country. This is valuable information which concerns the national measurement system as such. A deeper analysis of the situation could lead to a decision to facilitate and support the development of calibration laboratories which represent the *secondary level* of the national measurement system.

3.6. Decisions taken by the participating NMIs

Based on the analysis of the data, the NMIs determined the concrete need for action to close the identified gaps and to meet the objectives of the survey. This work included analysing the need for additional measurement standards and other equipment to either expand the existing calibration scopes or to establish new laboratories. The strategic timelines of these activities range from one to approximately five years.

The following points were among the reported planned actions:

- Constructing a new metrological laboratory building
- Basic metrology training for newly recruited metrological staff
- Seeking consultation on how to publish CMCs in the KCDB
- Developing capabilities for the preparation of certified reference materials (CRM)
- Strengthening the existing capacities in temperature, mass, and length
- Participation in interlaboratory comparisons in volume, length, and temperature

3.7. Action plan for joint and individual training activities supported by NPL India

One of the sub-objectives of this project was to assess the NMIs' needs for metrological services in order to have a solid decision base for the extension of the existing services and the development of new areas in metrology. In doing so, regional cooperation should play a major role. Therefore, a regional approach was facilitated from the very beginning. Of particular importance, however, was that the NMIs would share their experiences and data from the survey and use a joint approach to close the identified gaps in metrology. Although a face-to-face event could not be realized, joint virtual meetings were organized to discuss opportunities for regional cooperation. A strong ally was found in the National Physical Laboratory of India (CSIR-NPL), whose metrological capabilities are developed to a relatively high level. Of particular importance is the training programme that has been developed at the CSIR-NPL which is based on the theoretical and practical metrological expertise of its staff.

The meetings of the participating NMIs with CSIR-NPL resulted in a joint draft action plan to address the most pressing needs of the NMIs. Joint training activities and consultancies were planned, which included actions such as the following, among others:

- A five-day online training programme on basic metrology covering various metrological areas like mass, length, humidity, temperature, electrical parameters, etc.
- Capacity building in compression and tensile testing machine calibration
- Training in water meter verification
- Training in flow meter calibration
- Training in the calibration of pressure gauges

Responsibilities, desired outcomes, and deadlines were assigned to the planned actions. These joint activities could potentially indicate fields of future networking between the NMIs, including in areas of intercomparisons and knowledge exchange.



4. Summary and Lessons Learnt

Four national metrology institutes of the SAARC region participated in this regional demand survey exercise. They conducted a needs assessment amongst selected industries, government agencies as well as testing and calibration laboratories at the national level and jointly analysed the achieved results. Together, they developed a draft action plan to close the identified gaps with the support of a well-developed NMI in the region, the National Physical Laboratory of India (CSIR-NPL).

For this exercise, the NMIs were supported by independent experts in the preparation of the survey and the analysis of the received information. Based on the experts' advice, every NMI developed and applied their own methodology which can be repeated or adapted for further needs assessments, as this exercise initially focused on a selected, limited target group.

It must be mentioned that no personal interviews were conducted in the realized demand surveys due to the fact that this exercise fell during a time when no face-to-face activities were possible due to the Covid-19 pandemic. In a future needs assessment or similar undertaking, personal interviews should be included, as they have additional benefits related to the visibility of the NMI and to forming or reinforcing a partnership with the local industry. The changing needs of the stakeholders in metrology should be monitored continuously or reassessed after a certain period of time.

In the following, good practices for demand surveys in metrology are shown in a condensed format (see next page). They are derived from lessons learnt and experience gained from the conducted regional pilot exercise in the SAARC region and from other demand surveys that were used as case studies, for example, from India, Mongolia, the Philippines, and Armenia.

1. Use multiple distribution channels for the survey's questionnaire (e.g., mail, e-mail, customer contact, websites, newspapers). The use of online survey tools can increase the willingness of stakeholders to participate.

2. Use your contact channels to other NMIs in the region and beyond. Information on the needs of certain industrial sectors may be available. Collect this type of information, as this can save time and resources!

3. Increase efficiency by reaching out to potential clients through all available portals and partner institutions, including line ministries.

4. Seek in-person contact. If possible, visit your clients and work your way through the questionnaire or an interview checklist with them.

5. Train interview teams. Trained teams of interviewers* who conduct personal interviews can increase the efficiency of the survey significantly.

** Interviewers can be internal or external. If the staff situation allows, it is best to form internal teams of metrologists who focus on specific sectors or target groups and share their experience with the other teams. Assigning the teams to this task full-time for a set period of time can limit the duration of the survey.*

6. Cluster the target groups and be specific. Use different survey questions for calibration/testing laboratories versus for businesses in industry and other sectors.

7. Focus on target sectors. If resources are limited, focus on the key sectors first. Analyse the country's economic landscape and select the *big players*.

8. Be short, simple, and concise. A questionnaire should not be a burden for the respondents. However, all metrology-related needs should be surveyed, including training and consultancy needs.

9. Find the *right* person to interview. It is important that a person who is technically involved in measurement processes answers the questions or fills out the questionnaire.

10. Compile the received feedback systematically. Process data in a way that statistical conclusions can easily be drawn.

11. Take advantage of contact with clients. Try to obtain information on a client's needs whenever possible, including during on-site calibrations.

Sri Lanka: MUSSD involved the relevant line ministries through which sixty governmental institutions could be contacted to help providing demand information.

India: CSIR-NPL regularly conducts brainstorming sessions with industrial clients at which the NPL facilities can be visited; and clients' needs can be discussed. NPL scientists are in close contact with their clients who continuously update NPL about their calibration requirements.

The Philippines: In the 2016 demand survey of the national metrology institute of the Philippines, introduction letters were sent out to all targeted institutions to identify the right contact person to meet with or to send the questionnaire to.

Bangladesh: Client feedback was actively gathered during the provision of calibration services by BSTI's metrological staff, including on-site calibrations.

The Philippines: An online survey tool allowed questionnaires to be filled in directly at the website of the NMI of the Philippines.

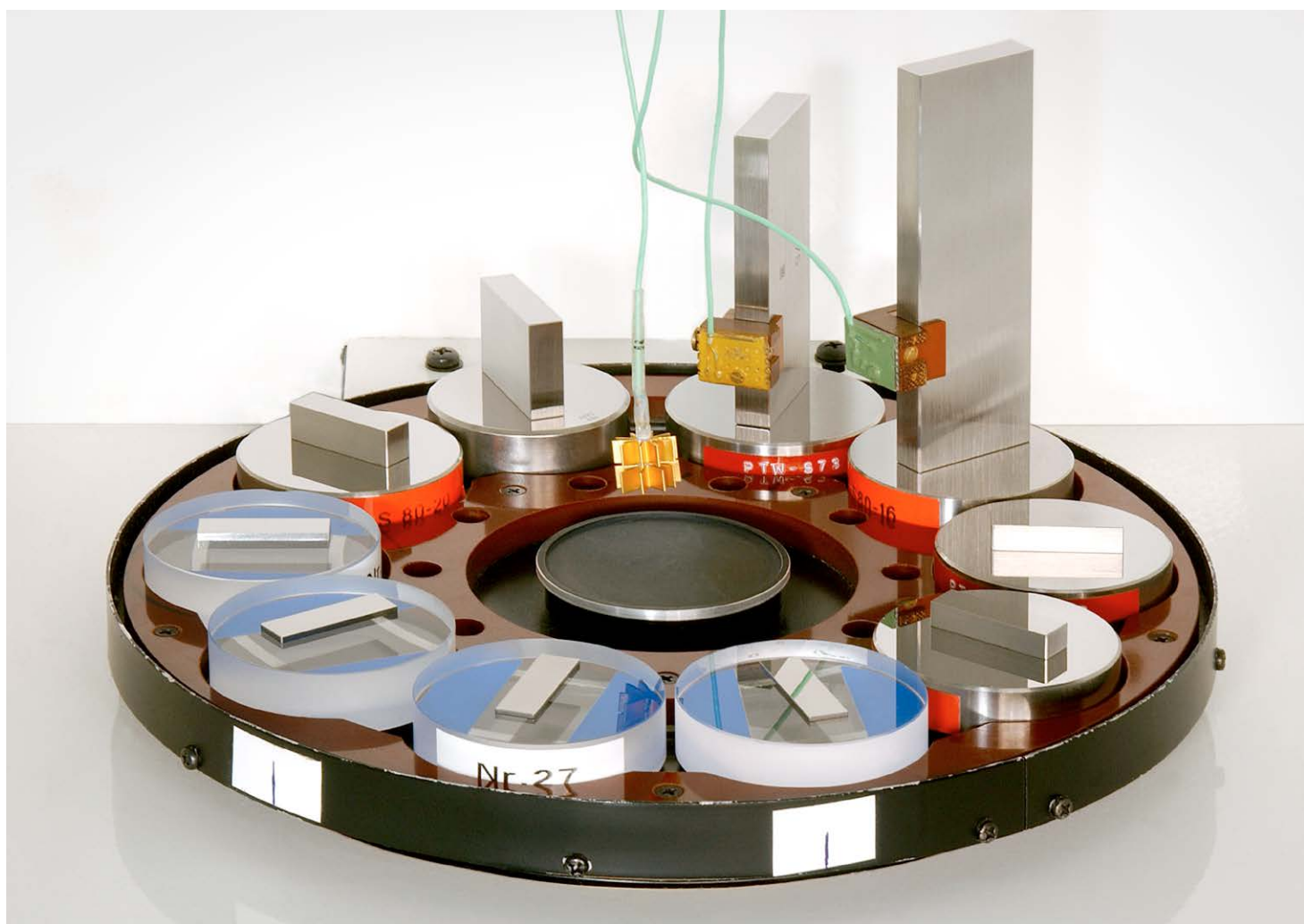
Bhutan: BSB has transferred all data on clients' equipment and other feedback to an EXCEL spreadsheet to produce statistics as needed.

SAARC: Some SAARC NMIs celebrate World Metrology Day (20 May) every year by hosting an awareness-raising event or hosting a conference/meeting with industry representatives to share information and learn about their demands and technical requirements.



To sum up, as resources are usually limited, ways to collaborate with peers in neighbouring countries should be sought – both in terms of determining the needs of stakeholders and establishing the necessary capabilities at the NMIs to meet those needs. This document provides guidance on a type of methodology that can be applied to determine the metrology demand and summarizes good practices derived from a practical pilot exercise in the SAARC region.

The authors would like to take this opportunity to thank all the national metrology institutes that took an active role in the pilot exercise and, thus, contributed to this paper.



Annex 1: Demand Survey Questionnaire for Services in Metrology – Laboratories

**Demand Survey
Questionnaire for
Services in Metrology**

LABORATORIES

Logo

Name of laboratory:	
Address:	
Contact Person / Respondent:	
Position:	
Phone:	
E-Mail Address:	
Date:	
Interviewer (if applicable):	

(1) General Information

Scope of services of the Laboratory			Area of Activity
Field of testing / calibration	Scope	Accredited (ISO/IEC 17025)	
		<input type="checkbox"/> Yes	<input type="checkbox"/> Calibration <input type="checkbox"/> Chemical Testing <input type="checkbox"/> Medical / Clinical Testing <input type="checkbox"/> Mechanical Testing <input type="checkbox"/> Biological / Micro-b Testing <input type="checkbox"/> Electrical Testing <input type="checkbox"/> Others (Please, specify):
		<input type="checkbox"/> No	
		<input type="checkbox"/> Yes	
		<input type="checkbox"/> No	
		<input type="checkbox"/> Yes	
		<input type="checkbox"/> No	
		<input type="checkbox"/> Yes	
		<input type="checkbox"/> No	
Please, use separate sheet of paper, if necessary. Thank you!			
How many technical personnel are involved in laboratory activities?	<input type="checkbox"/> 1 - 9 <input type="checkbox"/> 10 - 99	<input type="checkbox"/> 100 - 199 <input type="checkbox"/> > 200	
Does the laboratory operate a Quality Management System?	<input type="checkbox"/> Certified to ISO 9001 <input type="checkbox"/> Compliant to ISO 9001 <input type="checkbox"/> No <input type="checkbox"/> Other (pls. specify):	<input type="checkbox"/> Accredited to ISO/IEC 17025 <input type="checkbox"/> Compliant to ISO/IEC 17025	
Do you offer your services to other countries? If yes, which ones?	<input type="checkbox"/> No <input type="checkbox"/> Yes, to companies / labs in:		

Please attach copies of accreditation certificates if accreditation is granted by a foreign accreditation body. Thank you!

1 | Demand Survey Questionnaire LABORATORIES

(2) Measurement standards and measuring instruments used in the laboratory

Please, provide us a list of all measurement standards and measuring instruments used in the laboratory. Thank you!

The list should contain the following information:

- Equipment name
- Type (make / model)
- Number of devices of the same type
- Measurement range
- Resolution / accuracy class
- Calibration details: when last calibrated? Calibrating institution?

You can also use the following table to list the measurement instruments that need calibration.

Quantity	Equipment	Number / Quantity	Range	Resolution d (Readability) / Scale interval (e.g. 0.1g or 1mm)	Last Calibration (year)?	Calibrated by (institution)?	Verification necessary?	
							Yes	No
Mass	Balances							
		Analytical balance ($d \cong 0.01\text{mg} \dots 0.1\text{mg}$)						
		Precision balance ($d \cong 0.1\text{mg} \dots 1\text{g}$)						
		Industrial / Trade balance ($d \cong 1\text{g} \dots 10\text{g}$)						
		Others (please, specify):						
	Weights	OIML Class E2	..... pcs / sets					
		OIML Class F1	..... pcs / sets					
		OIML Class F2	..... pcs / sets					
		OIML Class M1	..... pcs / sets					
		Others (please, specify):						
Temperature	Liquid-in-glass thermometer							
	Resistance thermometer							
	Digital thermometer							
	Thermocouple							
	Others (please, specify):							
Pressure	Pressure gauge/manometer (oil)							
	Pressure gauges/manometer (gas)							
	Piston pressure balance							
	Others (please, specify):							
Length	Gauge blocks		..... pcs / sets					
	Vernier callipers							
	Micrometers							
	Plug / ring gauges							
	Screw thread gauges (plug / ring)							
	Tapes							
	Dial gauges							
	Fine pointers (dial indicator)							
	Others (please, specify):							

(3) Measurement Standards or measuring instruments that cannot currently be calibrated by the National Metrology Institute or any local provider

Equipment	Number / Quantity	Range	Resolution / Scale interval d (e.g. 0.1g or 1mm)

(4) Measurement-related needs

a) Did the laboratory participate in INTER-LABORATORY COMPARISONS or in a PT (Proficiency Testing) Program?

☐ No ☐ Yes (please, fill in the table below)

Measurement Field / Area	Artifact	Specification	Provider / Organized by	Year

b) What are the future needs in INTER-LABORATORY COMPARISONS or in terms of PTS?

Measurement Field / Area	Artifact	Specification / Accuracy

c) Please, indicate TRAINING that you need related to metrology

Training courses needed / topics of interest for training, etc.

d) Please, indicate **CONSULTANCY SERVICES** that you need related to metrology

[illegible]

(5) Comments & Suggestions

Please, make further comments, suggestions or recommendations

This image shows a single sheet of white paper with horizontal blue or grey ruling lines. The lines are evenly spaced and run across the width of the page. There are approximately 20 lines visible. The paper has a slight shadow on its right side, suggesting it's resting on a surface.

Thank you for your cooperation!

Annex 2: Demand Survey Questionnaire for Services in Metrology – Industry

Demand Survey Questionnaire for Services in Metrology	<div style="border: 1px solid gray; background-color: #cccccc; padding: 5px; display: inline-block; font-weight: bold;">INDUSTRY</div>	<div style="border: 1px dashed gray; width: 100px; height: 50px; margin: 0 auto;"></div> <p><i>Logo</i></p>
--	--	---

Name of company:	
Address:	
Contact Person / Respondent:	
Position:	
Phone:	
E-Mail Address:	
Date:	
Interviewer (if applicable):	

(1) General Information

Product(s) of your company 	Branch <input type="checkbox"/> Food / Beverage Industry <input type="checkbox"/> Agro-processing & Livestock <input type="checkbox"/> Construction and Construction Materials <input type="checkbox"/> Petrol Industry <input type="checkbox"/> Textile Industry <input type="checkbox"/> Retail Market <input type="checkbox"/> Pharmaceutical Industry <input type="checkbox"/> Chemical Industry <input type="checkbox"/> Automotive Industry <input type="checkbox"/> Metallurgy <input type="checkbox"/> Health Care (e. g. hospital) <input type="checkbox"/> Transport <input type="checkbox"/> Tourism <input type="checkbox"/> Power & Water Sector <input type="checkbox"/> Services <input type="checkbox"/> Others (Please, specify):				
Does the company operate a Quality Management System? If not, are you in the process of implementing a QMS?	Compliant to: <input type="checkbox"/> ISO 9001 <input type="checkbox"/> ISO 14001 <input type="checkbox"/> <input type="checkbox"/> No <input type="checkbox"/> Yes, according to Standard:..... <input type="checkbox"/> No				
Do you export products? If so:	<input type="checkbox"/> Yes <input type="checkbox"/> No % for export market To the following countries / regions:				
How many personnel are employed by the company?	<table style="width: 100%;"> <tr> <td><input type="checkbox"/> 1 - 9</td> <td><input type="checkbox"/> 100 - 199</td> </tr> <tr> <td><input type="checkbox"/> 10 - 99</td> <td><input type="checkbox"/> > 200</td> </tr> </table>	<input type="checkbox"/> 1 - 9	<input type="checkbox"/> 100 - 199	<input type="checkbox"/> 10 - 99	<input type="checkbox"/> > 200
<input type="checkbox"/> 1 - 9	<input type="checkbox"/> 100 - 199				
<input type="checkbox"/> 10 - 99	<input type="checkbox"/> > 200				

(2) Measurements performed in your company

Do you operate an in-house laboratory? <small>(for internal calibrations, tests, specific analyses, etc.)</small>	<input type="checkbox"/> Yes	<input type="checkbox"/> No
If yes, please also fill out Demand Survey Questionnaire for Laboratories . Thank you!		

1 | Demand Survey Questionnaire INDUSTRY

Please, for the types of measurements performed in your company, mark the metrological area and specify the significance for your product quality!

Please, also specify in the rightmost column where measurements are taken that are the basis for commercial transactions, and where instruments are used that are regulated by law in COUNTRY, respectively.

Quantity / Measurement Area	Significance (in terms of consequences due to non-conformities / wrong measurements)			Important for commercial transactions (to be ticked additionally when verification of the equipment is needed)
	Critical (for human life and health)	High important	Less important	
Mass (weighing of samples, goods, etc.)				
Temperature				
Pressure (medium gas or oil)				
Length / Dimensional				
Force				
Flow				
Electrical				
Time & Frequency				
Rel. Humidity (gas humidity)				
Moisture				
Torque				
Hardness				
Volume of fluids				
Density of fluids				
Density and Volume of solids				
pH				
Electrolytic Conductivity				
Viscosity				
Others (please add):				

(3) Measurement instruments used in your company

Please, provide us a list of measuring instruments used in the company that need calibration and / or verification. Thank you very much!

The list should contain the following information:

- Equipment name
- Type (make / model)
- Number of devices of the same type
- Measurement range
- Resolution / accuracy class
- Calibrated by (Supplier / Calibration Laboratory / National Metrology Institute – abroad or local)

You can also use the following table to summarize the types of measurement instruments that need regular calibration or verification.

Quantity	Equipment <i>If you have instruments of the same type but different ranges, please specify them in separate table</i>	Number / Quantity	Range	Resolution <i>d</i> / (Readability) / Scale interval (e.g. 0.1g or 1mm)	Calibrated?		Calibrated:		Verification required? Please, check additionally
					Yes	No	Abroad	Local	
Weighing Instruments / Scales	Analytical balance ($d \cong 0.01\text{mg} \dots 0.1\text{mg}$)								
	Precision balance ($d \cong 0.1\text{mg} \dots 1\text{g}$)								
	Industrial / Trade balance ($d \cong 1\text{g} \dots 10\text{g}$)								
	Weigh bridge								
	Others (please, specify):								
Mass / Weights	OIML Class E2	..... pcs./ sets							
	OIML Class F1	..... pcs./ sets							
	OIML Class F2	..... pcs./ sets							
	OIML Class M1	..... pcs./ sets							
	OIML Class M2	..... pcs./ sets							
	OIML Class M3	..... pcs./ sets							
	Others (please, specify):								
Temperature	Liquid-in-glass thermometer								
	Resistance thermometer								
	Digital thermometer								
	Thermocouple								
	Others (please, specify):								
Pressure	Pressure gauge / manometer (oil)								
	Pressure gauges / manometer (gas)								
	Piston pressure balance								
	Others (please, specify):								
Length	Gauge blocks	..... pcs./ sets							
	Vernier callipers								
	Micrometers								
	Plug / ring gauges								
	Screw thread gauges (plug / ring)								
	Tapes								
	Dial gauges								
	Fine pointers (dial indicator)								
	Others (please, specify):								

Quantity	Equipment <i>If you have instruments of the same type but different ranges, please specify them in separate table</i>	Number / Quantity	Range	Resolution <i>d</i> (Readability) / Scale interval (e.g. 0.1g or 1mm)	Calibrated?		Calibrated:		Verification required? Please, check additionally
					Yes	No	Abroad	Local	
Electrical	Hand-held multimeter								
	Digital multimeter								
	Current Clamp								
	Stop watch								
	Resistors								
	Frequency counters								
	Others (please, specify):								
Flow	Flowmeter (gas)								
	Flowmeter (fluids)								
Force	Compression tester								
	Tensile tester / spring scale								
Rel. Humidity	Hygrometer								
Moisture	Moisture meter								
Torque	Torque wrenches								
	Torque tester								
Hardness	Hardness tester								
	Reference blocks								
Volume	Glassware								
	Provers / Test measures								
	Pipettes								
	Micro Pipettes								
Density	Density meter								
	Pycnometer								
	Hydrometer								
pH	pH meter								
Electrolytic conductivity	Conductivity meter								
Viscosity	Viscometer								

(4) Measuring instruments that cannot currently be calibrated or verified by the National Metrology Institute or any local provider

Equipment	Number / Quantity	Range	Resolution / Scale interval d (e.g. 0.1g or 1mm)

(5) Measurement-related needs

a) Please, indicate **TRAINING** that you need related to metrology

Training courses needed / topics of interest for training, etc.

b) Please, indicate CONSULTANCY SERVICES that you need related to metrology

Consultancy services needed

(6) Comments & Suggestions

Please, make further comments, suggestions or recommendations

Thank you for your cooperation!

Abbreviations

ANSA	Afghanistan National Standardisation Authority
BSB	Bhutan Standards Bureau
NML-BSTI	National Metrology Laboratory Bangladesh
CMC	Calibration and Measurement Capabilities
CRM	Certified Reference Material
CSIR-NPL	Council of Scientific & Industrial Research – National Physical Laboratory India
KCDB	Key Comparison Database
MSMU	Maldives Standards & Metrology Unit
MUSSD	Measurement Units, Standards and Services Department Sri Lanka
NBSM	Nepal Bureau of Standards and Metrology
NMI	National Metrology Institute
NML-BSTI	National Metrology Laboratory – Bangladesh Standards & Testing Institution
NPSL	National Physical and Standards Laboratory Pakistan
PT	Proficiency Testing
PTB	Physikalisch-Technische Bundesanstalt
QI	Quality Infrastructure
SAARC	South Asian Association for Regional Cooperation



Imprint

Published by

Physikalisch-Technische Bundesanstalt
Bundesallee 100
38116 Braunschweig
Germany

Responsible

Susanne Wendt
+49 531 592-9030
susanne.wendt@ptb.de
www.ptb.de/9.3/en

Text

Anett Matbadal, Dr. Vijay Chitnis, Uwe Miesner

Title image

© iStock

As of September 2022



Contact

Physikalisch-Technische Bundesanstalt

International Cooperation

Susanne Wendt

Phone +49 531 592-9030

Fax +49 531 592-8225

susanne.wendt@ptb.de

www.ptb.de/9.3/en