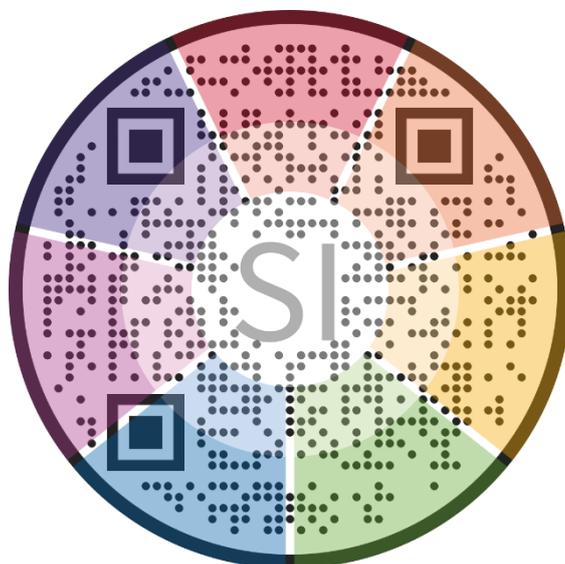


EVALUATION REPORT SURVEY ON DIGITAL TRANSFORMATIONS



Working document for comments

This document was prepared from the response to the survey on digital transformation circulated amongst the members of the CIPM Consultative Committees. It is open for comments until 10th December 2022. Please send any comments to Olav.Werhahn@bipm.org and Gregor.Dudle@bipm.org.

Survey on digital transformations among CC members

Evaluation Report

1 Executive Summary

The CIPM initiated a survey on the current and planned activities of NMIs on digitalization. A questionnaire was designed and circulated to members of all CIPM Consultative Committees (CCs).

The survey was carried out in the first half of 2022 by circulating the questionnaire to **827** CC members. In total, **174** questionnaires were **returned**. On average, the **return rate** is thus **21 %**, however, it varies on specific questions and on CCs.

The main findings of the survey are:

- **Digital transformation is a concern to many NMIs.**
 - **56 %** of all respondents have at least one digital project or plans to start one.
 - **Digital transformation** is in many NMIs still at an **early stage**. On average, **29 %** of CC members reported **stakeholder contact on digital topics** over the last 5 years. There is, however, a **significant variation between CCs**, as this value ranges from **43 % (CCU) to 12 % (CCQM)**.
- **DCC is the DT-topic with the greatest interest to NMIs.**
 - Among the different DT topics, digital calibration certificate is the most mentioned topic of interest to NMIs. Of all respondents with digital projects, **68 %** reported to work on **DCCs**.
 - Of the respondents with little DCC knowledge (typically not having ongoing DCC projects), **39 %** still considered **DCCs would be of beneficial** to their **customers**.
 - The best-known **format** for DCCs is **xml**.
- **The concept of how to provide a statement of metrological traceability in DCCs is not yet clear.**
 - Of the CC members expressing an interest in DCCs, **only 15 %** were able to **articulate** how **metrological traceability** to the SI could be addressed in a **DCC**.
- **API-KCDB is still at early stage of usage.**
 - On average, **7 % of the respondents used the API-KCDB**; another **42 % plan to do so**.
 - **22 %** of the participants feel they have **sufficient information about the API-KCDB**. This is less than a third of the participants that responded to have an active role in the KCDB.

A range of minor differences between the different CCs, can be seen in the full report. However, no gross CC-specifics have been determined by the survey results.

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2 Introduction

At its 110th meeting, “the CIPM supported the plan for a Consultative Committee survey on NMI/DI plans for digital calibration certificates and engagement with the Digital SI Framework.” (Decision CIPM/110-23(2021) To obtain an overview of the ongoing activities and future plans of the NMIs regarding digital transformation (DT), the BIPM developed a questionnaire. In line with the decision, the BIPM intended to collect the data through the CIPM Consultative Committees (CCs) as this allows the identification of any potential CC-specific aspect of digital transformation. Accordingly, the questionnaire was circulated to members of all CCs. The questionnaire comprised a total of 33 questions and covered the following aspects:

- Digital Calibration Certificates and SI-traceability;
- interaction with stakeholders;
- technical details of digital transformation;
- usage and visibility of the API-KCDB.

The questionnaire and some automatically generated (MS Forms) reviews are available in Appendix A.

The survey was carried out in two phases: in a first step, the survey was sent to CCAUV and CCEM members in November 2021. Based on the positive insights gained in this step, all other CCs were invited to participate in the survey by the same questionnaire in June/July 2022. This way, all responses from CC members can be compared. This report presents the evaluation of all results from all CCs.

3 Participants and return rates

The questionnaire was sent out to all official members of the ten CCs. The Database of the last recorded delegation served as basis for the mailing which amounts to a total of 827 addressees. The following paragraphs give an analysis of the return rate by CC and by question.

3.1 Position of respondents in their institute

Figure 3 to Figure 10 show the position of the respondents within their institute for each CC. Generally speaking, the survey was replied by NMI staff in higher positions; categories *Director* to *Principle Scientist* summing up in all CCs to more than 50 % off all returns.

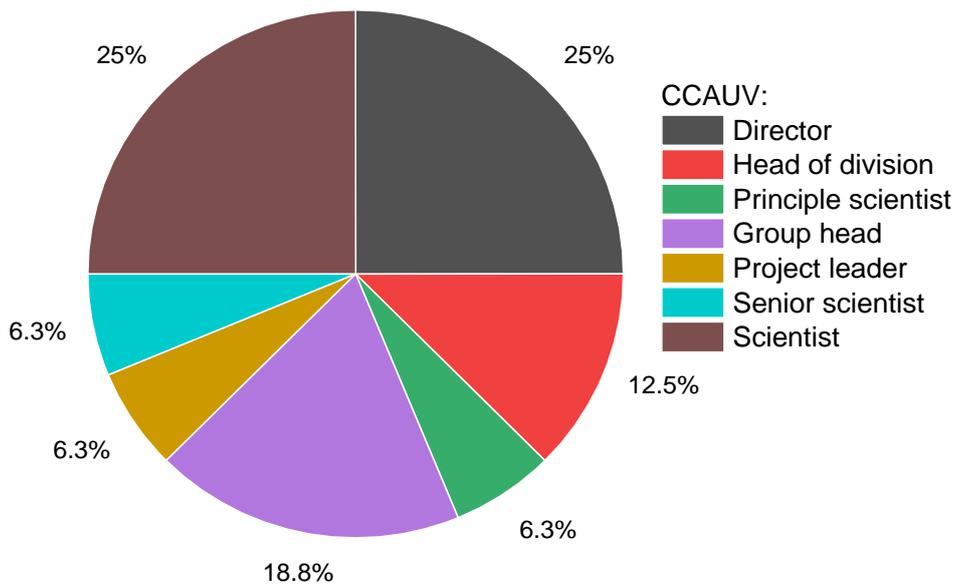


Figure 1: Positions of respondents from CCAUV participants.

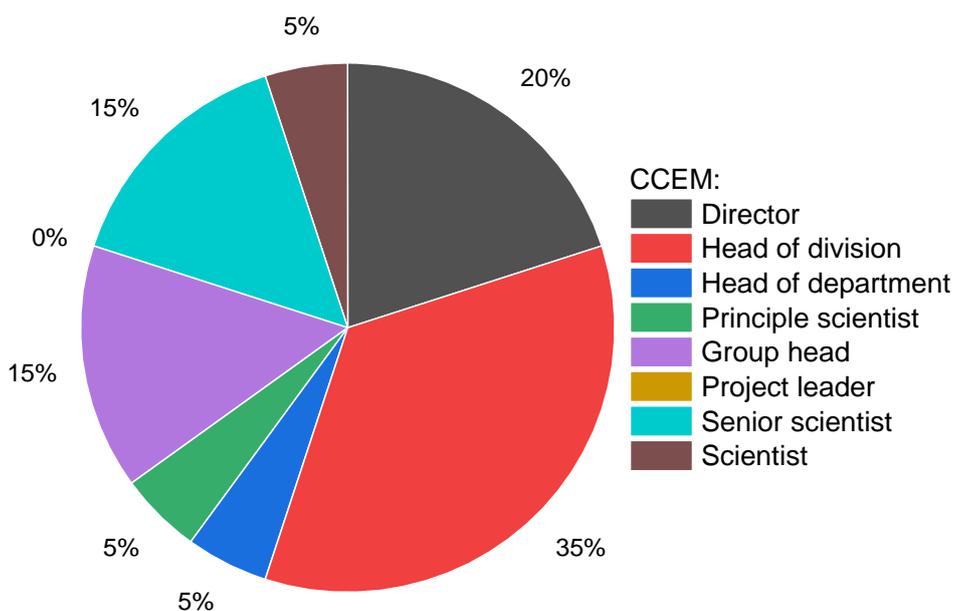


Figure 2: Positions of respondents from CCEM participants.

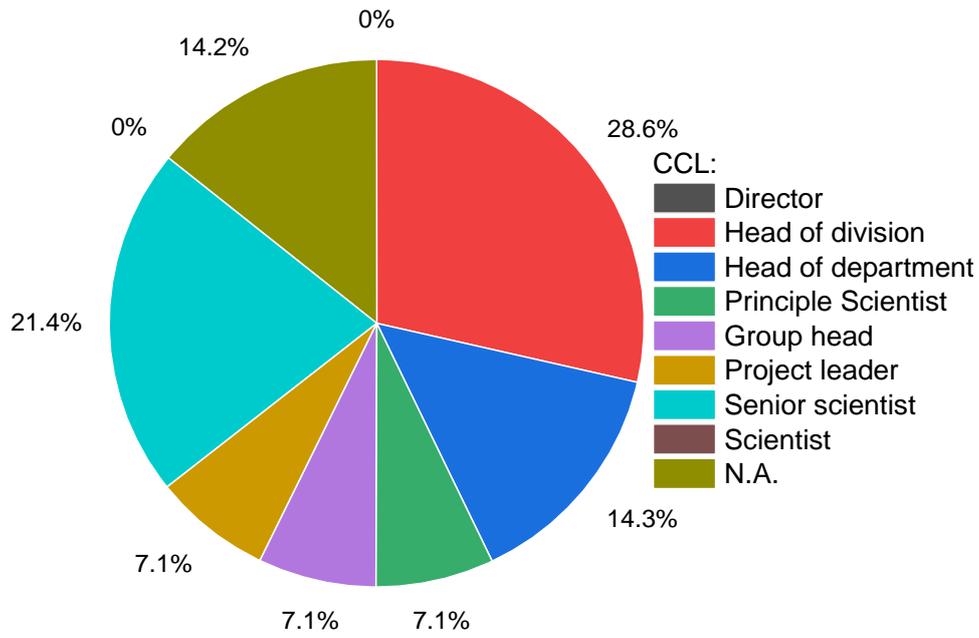


Figure 3: Position of respondents of the CCL participants

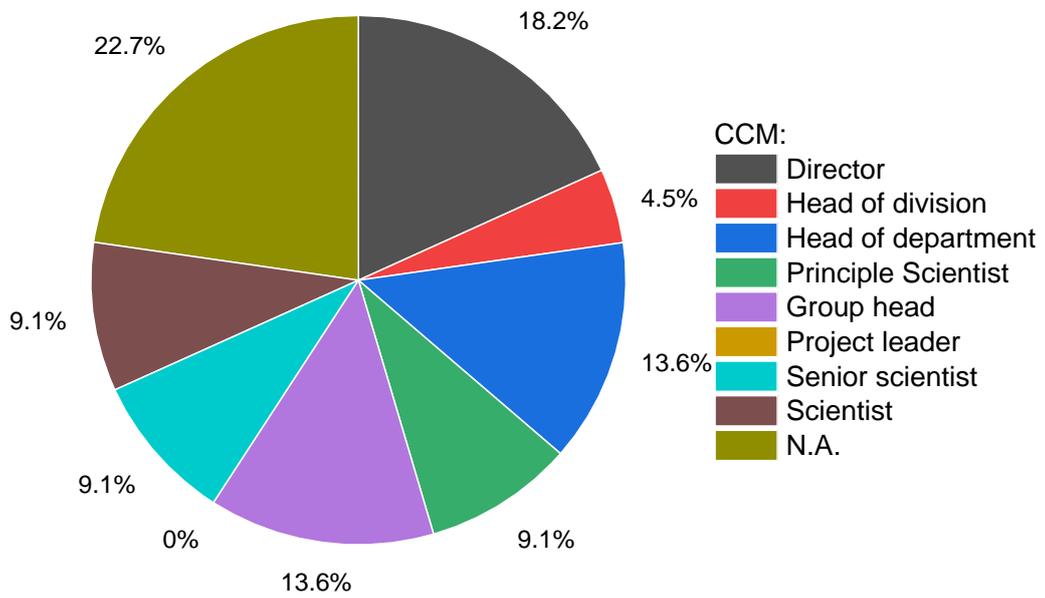


Figure 4: Position of respondents of the CCM participants

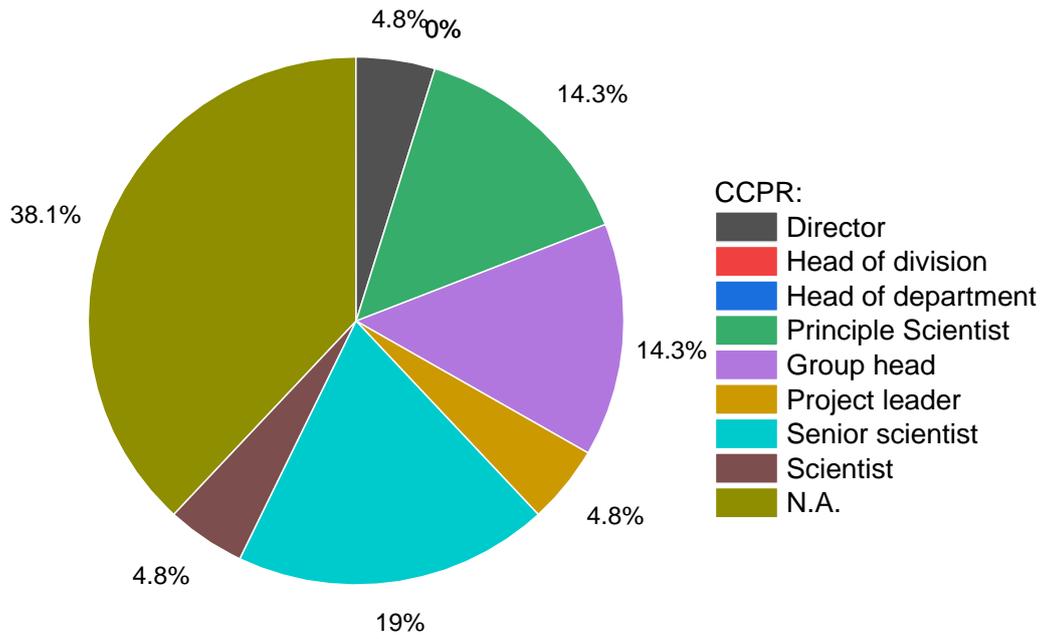


Figure 5: Position of respondents of the CCPR participants

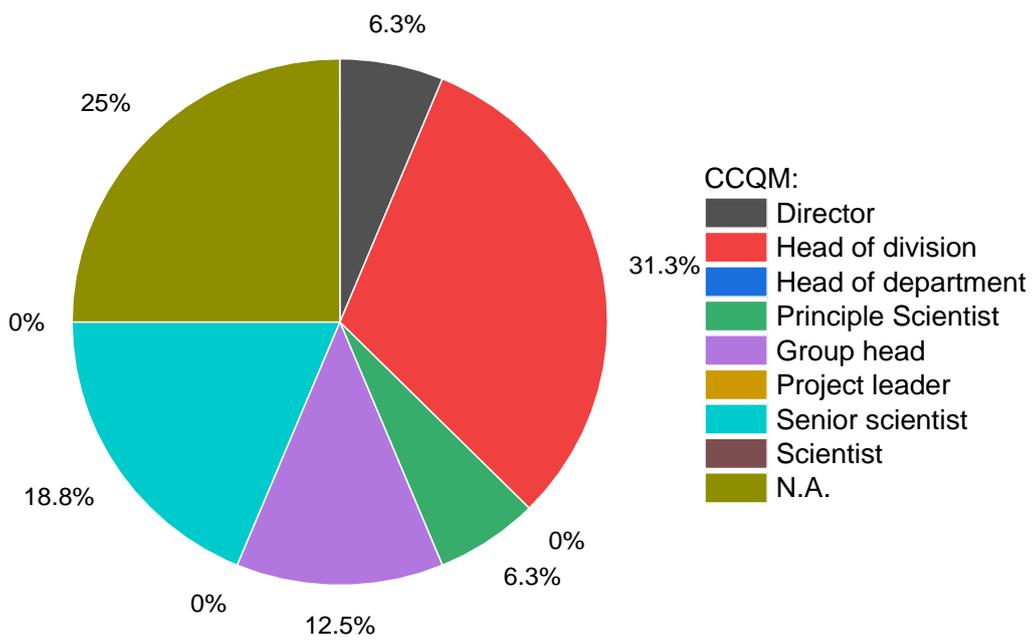


Figure 6: Position of respondents of the CCQM participants

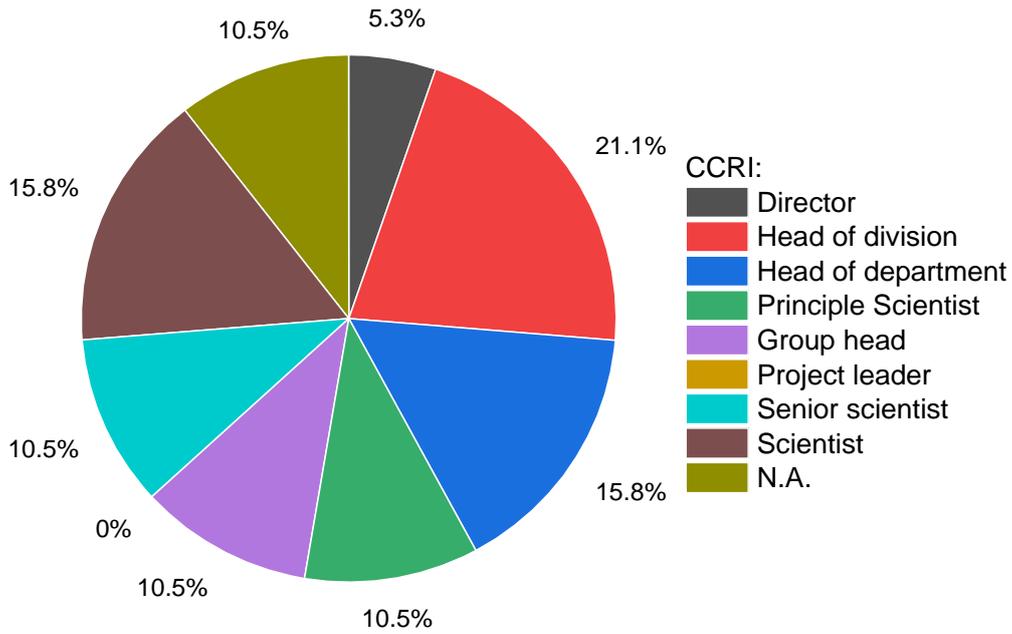


Figure 7: Position of respondents of the CCRI participants

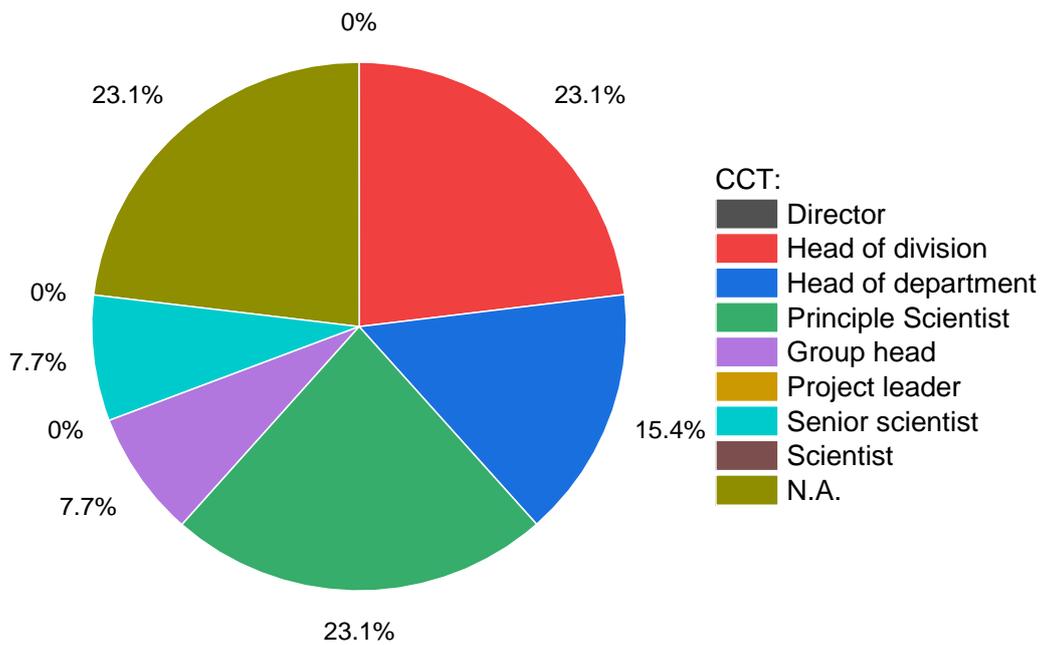


Figure 8: Position of respondents of the CCT participants

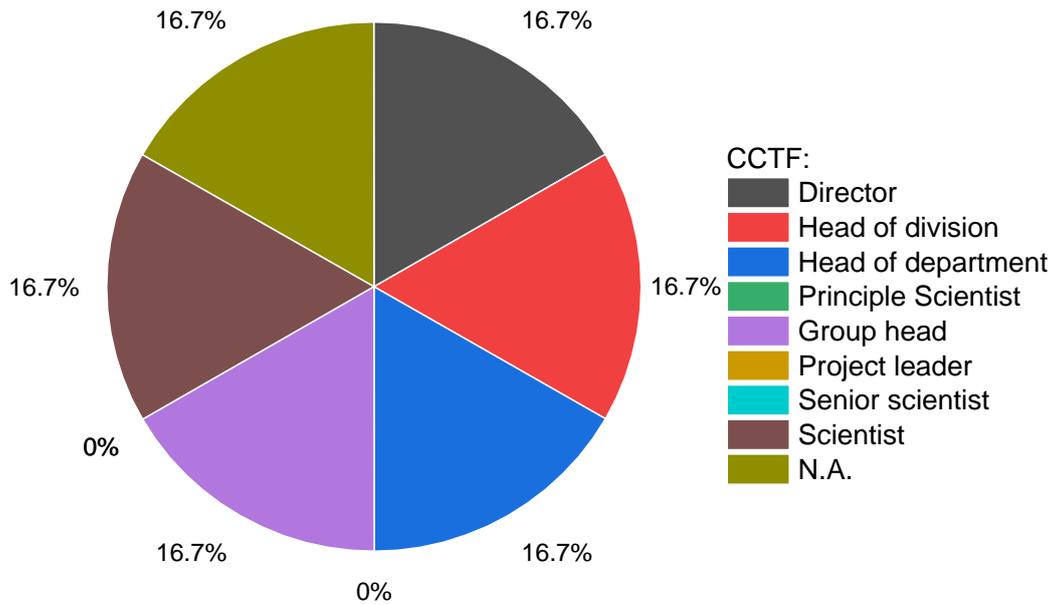


Figure 9: Position of respondents of the CCTF participants

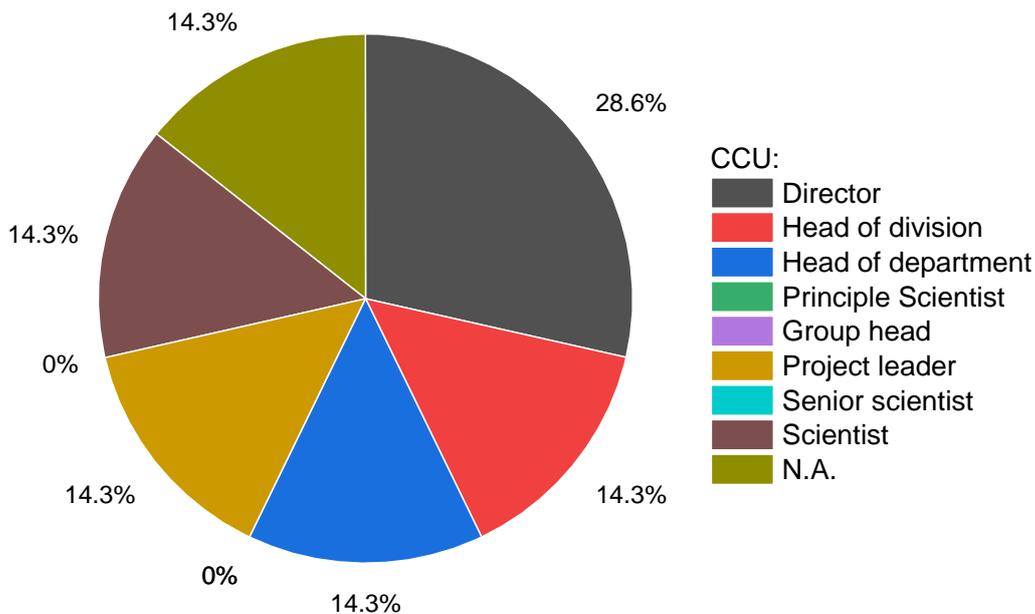


Figure 10: Position of respondents of the CCU participants

3.2 Return rate by Consultive Committee

The survey was sent to 827 CC members. It was advertised in all CC to encourage all members to participate. In total, 174 forms were returned, which corresponds to an overall return rate of 21 %. However, this value varies significantly among the CCs, with the CCEM achieving the highest (36 %) and the CCU having the lowest value (less than 10 %). Figure 11 shows the return rate broken down for all 10 CCs. It appears that the CC of the pilot (CCAUV and CCEM) have a higher return rate than the remaining CCs.

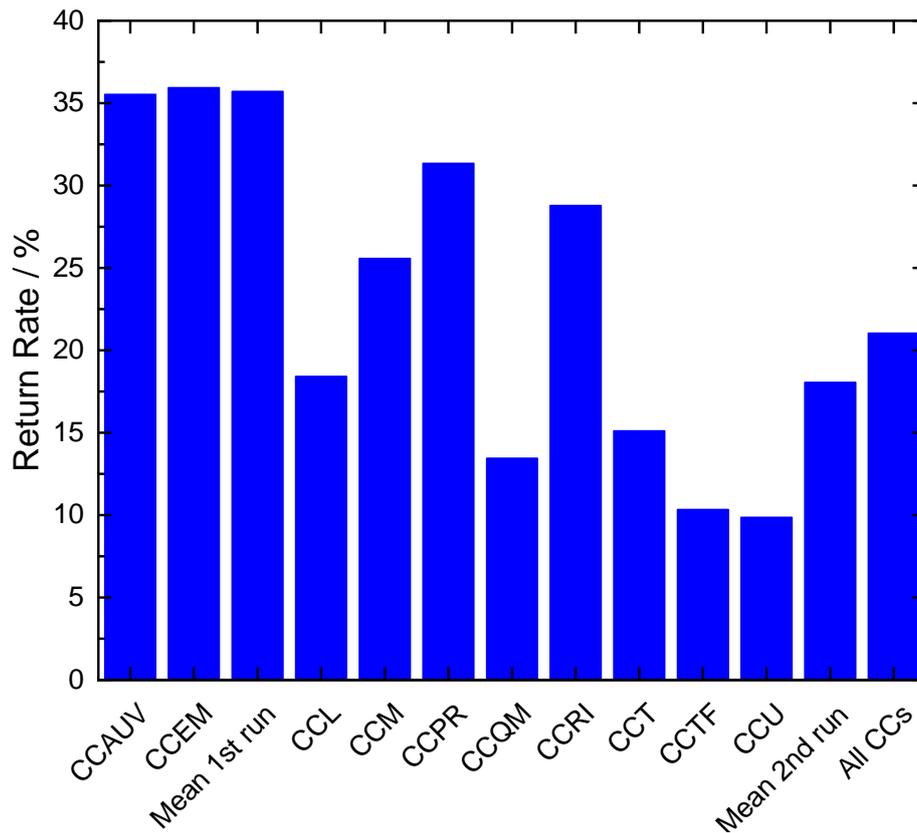


Figure 11: Return rates of the questionnaire sent to CC members.

Available online information¹ suggests that the return rate achieved for this survey is comparable to other online surveys. Indeed, return rates between 5 % and 30 % are considered normal for questionnaires sent out to *internal participants* (i.e. known by the organizer).

3.3 Return rate by question

Not all questions have been answered by all participants. Figure 12 gives the return rate for each question of the survey, broken down by CC.

¹ <https://www.smartsurvey.co.uk/blog/what-is-a-good-survey-response-rate>

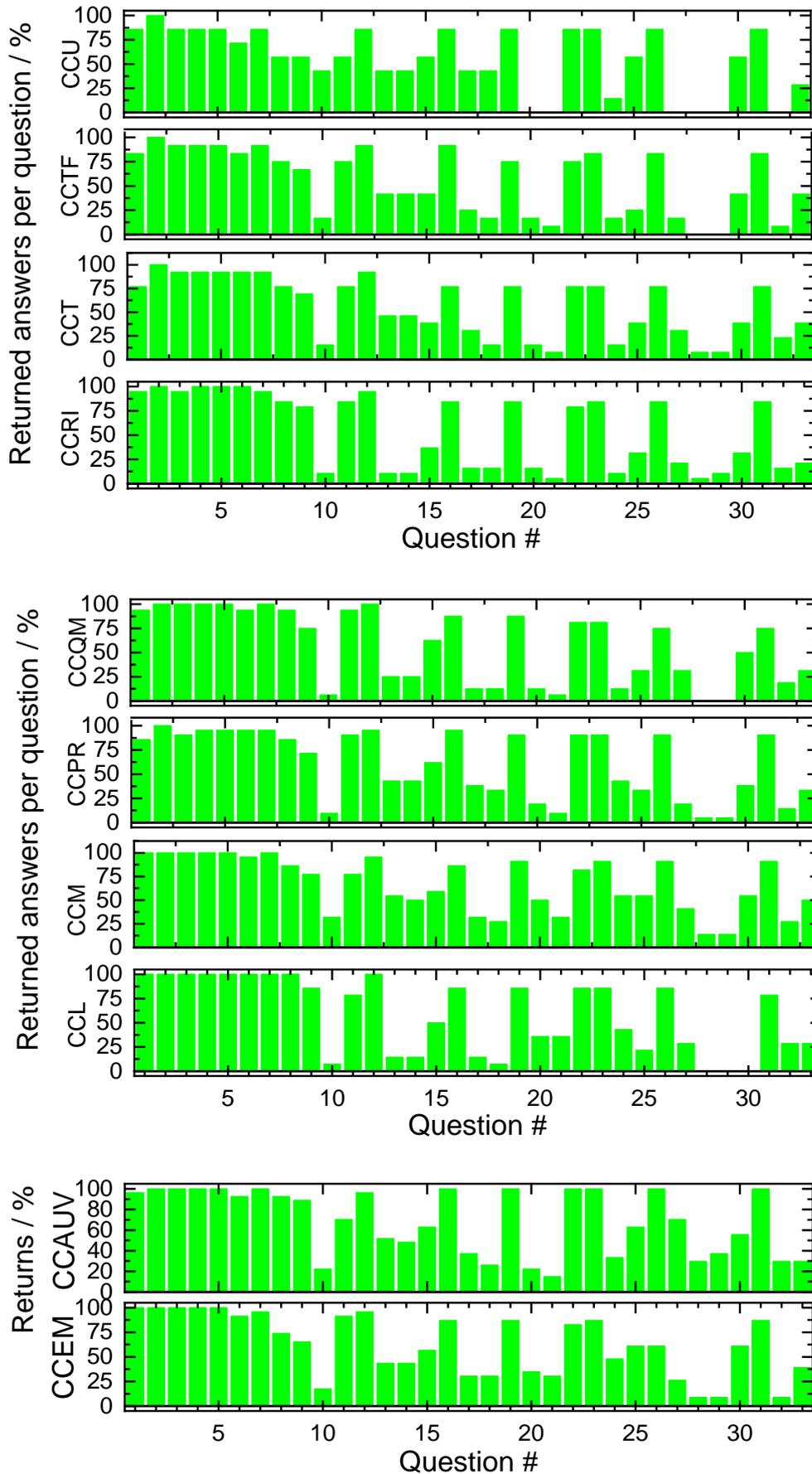


Figure 12: Return rates to the specific questions in the survey from CCs

If the more general questions (who is responding, type of involvement with the KCDB, contacts with stakeholders) are answered by all participants, the more technical questions (#11, #13, #14, #20, #21, #24, #30, #32) have significantly lower return rates.

Less than 50 % of returned questionnaires contain feedback on more technical aspects, the question regarding the customer relevance and SI-traceability in digital transformation work (#21) achieving the lowest score: only 19 participants returned an answer which corresponds to a return rate of only 15 %. Given the fact that many participants stress the high relevance of DCCs (see Table 10), this figure is surprisingly low.

3.4 Person-equivalence per CC

The less answers one gets from a specific group, the more weight the received individual answers will have. This can be visualised by calculating the *%-person-equivalence*. It is defined by the inverse of the number of returned answers expressed in percentage. Figure 13 gives the *%-person-equivalence* for each CC.

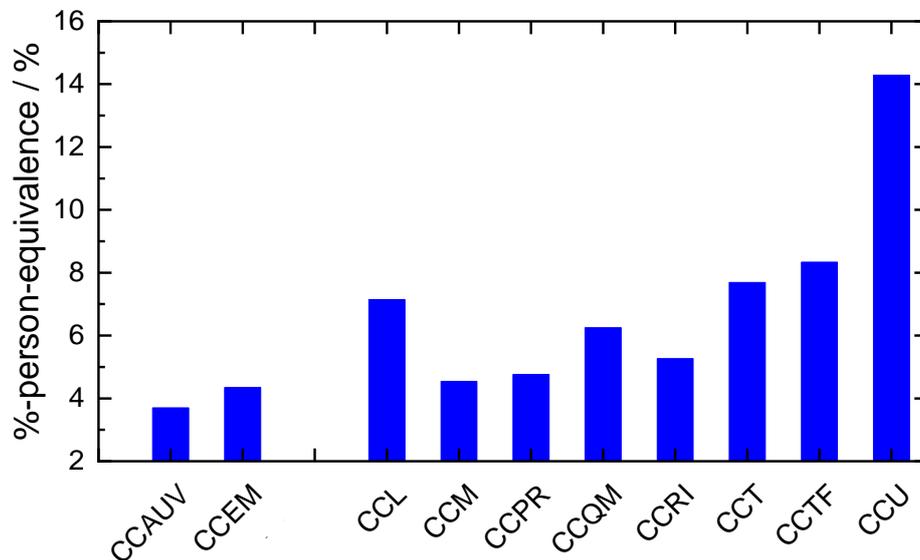


Figure 13: Weight of a single answer on questions returned from CC members in percent.

From its comparably large *%-person-equivalence* the individual CCU respondent had the largest influence on the CC specific answers as compared to the other CCs individuals.

3.5 Relevance of the topic for CC members

As shown in Figure 11, the return rate of the survey is 21 %. Even if this Figure is in the normal range for surveys in general, the result is below the expectations, given the fact that the survey was initiated by the CIPM and that it was widely communicated in advance.

When analysing the data more closely, it appears that the interest in the digital transformation varies by a factor of 2 to 3 between the different CCs: whereas the return rate for two CCs (CCAUV and CCEM) has reached 36 %, it is as low as 10 % for others (CCTF and CCU).

There seems to be a slight correlation between the stakeholder interest and the return rate of this survey. Question #16 asked about the frequency of stakeholder requests regarding DCCs or digital

services (full data presented in Table 5). Table 1 shows the sum of stakeholder contacts (“one”, “a few”, “>5”, “>10”) together with the return rate.

As it turns out, CCs whose members have more stakeholder contacts, tend to have a higher return rate in this survey. This becomes even more obvious if one displays the product of stakeholder contacts and questionnaire return rate. The average value of this indicator is $609 \cdot 10^{-4}$. The values for CCAUV, CCEM, and CCPR are all above average (all $> 1000 \cdot 10^{-4}$) and correspond to the CCs with the highest return rate. Figure 14 displays this graphically.

Table 1: Relevance of the DT topic to CC participants from correlations on answers to question #16 and the return rate.

CC	Stakeholder contacts / %	Questionnaire return rate / %	Digital-relevance product / 10^{-4}
AUV	38	36	1368
EM	35	36	1260
L	14	18	252
M	33	26	858
PR	39	31	1209
QM	12	13	156
RI	16	29	464
T	31	15	465
TF	25	10	250
U	43	10	430
Mean	29	21	609

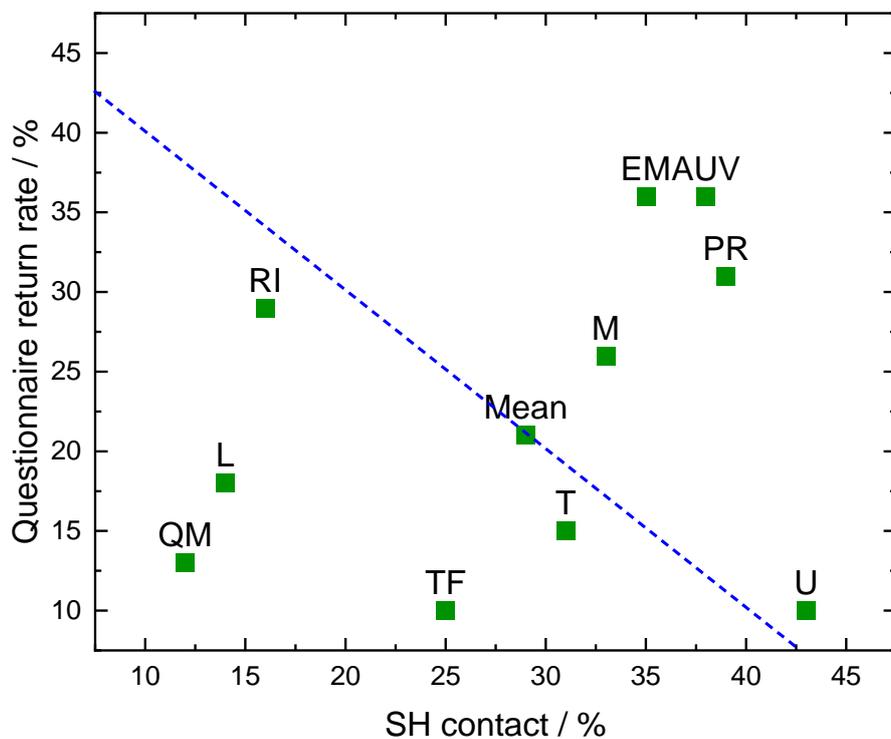


Figure 14: Stakeholder (SH) contacts and questionnaire return rate showing those CCs with high digital-relevance-product on the top right of the dashed line.

4 DCCs and SI-traceability

4.1 Topic with the highest importance

Questions #11 to #13 try to identify the topic of digital transformation with the most interest in the community.

Most of the answers reported back were in relation to Digital Calibration Certificates (DCCs). No other topic received a similar count of mentions. By a large margin, DCC seems therefore the highest priority for most NMIs.

4.2 SI-traceability

DCCs might be the most mentioned topic in general, the statement needs to be nuanced somewhat if it comes to the details. Indeed, the survey suggests that not all participants share the same concerns regarding DCCs. Questions #20 to #22 focused on more technical details regarding DCCs. It turns out that even for the participants who have some knowledge about DCC (question #20), the SI-traceability is not the main concern. Indeed, only 15 % of the participants regard the SI-traceability statements in the DCC as an issue. Table 2 summarizes returned answers.

Table 2: SI traceability in digital calibration certificates and its origin. Numbers are based on returned feedback on question #21.

CC	Returns #20 in %	Returns #21 / relative to #20 in %	Details in examples
AUV	22	7 / 25	<ul style="list-style-type: none"> ■ Through statement to national standards ■ https://gitlab1.ptb.de/d-ptb/d-si/xsd-d-si
EM	34	4 / 13	<ul style="list-style-type: none"> ■ List of standards used with calibration due date plus statement that these are calibrated at NMIs or accredited cal labs, etc.
L	36	3 / 60	<ul style="list-style-type: none"> ■ text field ■ 'digital traceability'
M	50	0 / 0	-
PR	19	0 / 0	-
QM	6	0 / 0	-
RI	16	0 / 0	-
T	15	0 / 0	-
TF	17	1 / 50	<ul style="list-style-type: none"> ■ hyperlink to KCDB UTC key comparison and CMC
U	0	0 / 0	-
Mean	22	4 / 15	<i>SI traceability seems not that much in focus of present DCC discussions yet</i>

This result is important for the CIPM MRA. Laboratories holding CMCs published in the KCDB, can get authorization to use the CIPM MRA logo on their calibration certificates (<https://www.bipm.org/en/cipm-mra/logo>). Since DCCs are the digital output of a calibration performed by an NMI/DI, the same CIPM MRA rules should apply to both, digital and non-digital certificates. The metrological traceability of the data must thus play a crucial a role in the process and should be dealt with in a similar way by all participants in the CIPM MRA.

4.3 DCC format

Table 3 lists the returns on questions #20 (DCC formats, the participants are aware of), together with the participants' view to whether a provision of DCCs would benefit the NMI's/DI's services to customers (#22). As already seen in Figure 12, the return rate to this question is among the lowest of the whole survey.

The DCC format with the most mentions is xml, followed by a so-called PTB-format, pdf/A3 being in third position. Table 3 lists 'DCC formats' responded by survey participants, well knowing that the returned answers are not always comparable data formats. On average, 39 % of the survey participants think that providing a DCC would benefit their customers, whereas on the contrary only 6 % said that there would be no benefit. The missing 55 % seemed indecisive.

Table 3: DCC formats (question #20) and views on achievable customer benefits (question #22) by means of DCC provisions.

CC	Top score	Other scores	customers would benefit	
			Yes / %	No / %
AUV	PTB	xml	37	7
EM	xml	pdf/A3, PTB, FLUKE	48	4
L	xml	PTB, pdf/A3	50	14
M	xml	JASON, pdf/A3, PTB	27	9
PR	xml	PTB, pdf/A3, JASON	62	0
QM	xml	text format	38	6
RI	PTB	DCR, DCA, DTC	32	11
T	xml	PTB	23	0
TF	xml	digitally signed pdf	42	8
U	-	-	29	0
Mean	xml	PTB, pdf/A3	39	6

5 Interaction with stakeholders

Several questions of the survey focused on the interaction of the NMI with their stakeholders.

5.1 NMI experts in touch with Stakeholders

Table 4 summarises the results on question #8 assessing whether CC members are in a position to recognize stakeholder (SH) needs and question #9 asking whether they had been in touch with SHs regarding projects about DT. The third column of Table 4 shows the percentage of project engagement with SHs that led to their own plans to initiate digital services.

It is very striking that collaborating with SH in a project where digital transformation was of concern has only been reported by 18 % of the survey participants. However, it has directly led to the development of proprietary digital services at 94 % of those participants who have been engaged in such projects.

Table 4: NMI experts in touch with Stakeholders as based on feedback to questions #8, #9, #10.

CC	SH needs able to see – 'yes' returns on #8 in %	Returned 'Yes' #9 in %	Returned 'Yes' in #10 relative to #9 in %
AUV	89	22	100
EM	65	17	100
L	86	7	100
M	77	32	86
PR	71	10	100
QM	75	6	100
RI	79	11	100
T	69	15	50
TF	67	17	100
U	57	43	100
Mean	74	18	94

5.2 Number of customer demands received on DT services

Question #16 focused on the number of customer demands on digital services received by the NMIs. Participants were asked to specify how often they received requests from customers over the last five years. Table 5 summarizes the results.

Table 5: Number of customer requests on DT services of NMIs as derived from feedback on question #16 in % of the returned questionnaires per CC.

CC	One	a few	> 5	> 10	none	n.a.
AUV	4	19	15	0	63	0
EM	0	22	9	4	52	13
L	0	14	0	0	71	14
M	5	5	14	9	59	
PR	5	24	5	5	53	5
QM	0	6	6	0	75	12
RI	0	11	0	5	68	16
T	0	31	0	0	46	23
TF	0	17	0	8	67	8
U	0	14	0	29	43	14

Mean	1	16	5	6	60	12
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From answers to question #16 it appears that the majority of CC members did not receive requests on digital services from customers or only a few during the last five years.

5.3 NMI customers' requests on DCCs and d-SI

Questions #17 and #18 addressed the customer orientation of the NMIs with respect to digital transformation. Question #17 assessed the type of customers asking for digital services and #18 trying to infer needs and benefits in specific CC subfields from DCCs and/or digital SI-based services. The feedback is summarized in Table 6. The number of answers to both questions again varies among CCs. However, the share of participants that provided feedback to these questions is in all cases less than 50 %.

Table 6: Locating NMIs' customer requests on digital calibration certificates and digital SI framework in subfields of the metrology area.

CC	Return rate in % of the total feedback, #17/#18	Comments on customer demands
AUV	37/25	<ul style="list-style-type: none"> ■ Data-driven calibration is needed for the remote calibration of vibration sensors that are not retrievable/not accessible ■ Beneficial for plug-and-play incorporation of calibrated sensors into the network without the need for human entry of calibration information ■ On-site calibration of digital accelerometers
EM	30/22	<ul style="list-style-type: none"> ■ Automotive industry ■ SME to large scale customers ■ Multifunction calibrators and meters which covers multiple fields (DC voltage, DC current, DC resistance, AC voltage, AC current). The calibration report has large numbers of (easily over 100) measurement points ■ Tests of pre-conformity RF anechoic chambers for application of electromagnetic tests on electrodomestic appliances
L	14/7	<ul style="list-style-type: none"> ■ Accredited laboratories ■ 'Benefit: Yes but need: No'
M	32/27	<ul style="list-style-type: none"> ■ Automatation of processes ■ Increasing efficiency ■ naming individual large industry customer
PR	38/29	<ul style="list-style-type: none"> ■ Big data handling ■ spectral data sets with correlated quantities
QM	13/13	<ul style="list-style-type: none"> ■ Proficiency test data results in accreditation processes
RI	16/16	<ul style="list-style-type: none"> ■ Sensor networks
T	31/15	<ul style="list-style-type: none"> ■ Predictive performance in temperature and humidity
TF	25/17	<ul style="list-style-type: none"> ■ NPT and PTB services
U	43/43	<ul style="list-style-type: none"> ■ IoT ■ TC125 health informatics ■ Combining heterogeneous and complex information data for decisions in meteorology or medical diagnostics
Mean	28/21	<i>the level of depth on the overall customer request seems not that much developed and concrete</i>

5.4 CIPM MRA activities *versus* stakeholder push on digital transformations

With question #4 to #6 the survey focused on the participants' involvement in the CIPM MRA. Questions #12 and #16 concentrated on stakeholder contacts. Table 7 shows the results to these questions side by side.

Table 7: Returned participants' KCDB roles (question #4) and CIPM MRA activities (question #5) compared to their stakeholder (SH) contacts (question #16) and received requests from customers on digital transformations (question #12).

CC	KCDB role / %	CIPM MRA activities / %	SH contacts / %	DT requests ¹ / %
AUV	74	59	38	59
EM	78	65	35	35
L	57	64	14	21
M	68	55	33	55
PR	91	62	39	43
QM	75	69	12	19
RI	90	68	16	11
T	62	77	31	31
TF	75	58	25	42
U	14	14	43	43
Mean	68	59	29	36

¹DT requests as inferred from question #12 by summarizing participants who returned responses other than 'No'.

Whereas most participants of the survey have an active role in the KCDB (68 % on average) and take part in CIPM MRA activities (59 % on average), the reported demand from stakeholders is far smaller. On average, 29 % of the participants were in contact with stakeholders on DCCs and other digital services during the last five years, and only 36 % of them have received enquiries from customers about digital services.

6 API-KCDB

The KCDB was updated in 2020 with an Application Programming Interface (API) to facilitate machine-access on CMC data. This is an initial step on the way to FAIR data in the KCDB and CIPM MRA activities. One goal of the survey was to get a view on the position of the API-KCDB among the digitalization topics in the community. Two aspects were assessed in this survey: the current and planned usage of the API-KCDB among the participants and the visibility and knowledge about the tool.

6.1 Usage

A first question asked the participants to position their knowledge about the API-KCDB (#23: “I am informed”, “I need more information”), a second question targeted the usage of the tool (#24: “I used it”, “I will use it”, “I have no plans in place”). Table 8 summarizes the results received.

Table 8: Knowledge about the API-KCDB as given by the feedback ratio of ‘I am informed’ and ‘will need more information’ to all CC responses and ‘will use it’ an ‘no plans yet in place’ with respect to those saying ‘I am informed’ about the API-KCDB.

CC	‘am informed’ / %	‘need more information’ / %	‘used it / %’	‘will use it’ / %	‘no plans in place’ / %
AUV	30	46	0	22	78
EM	48	30	4	36	64
L	29	43	14	50	50
M	43	32	14	78	56
PR	24	43	10	0	100
QM	6	63	6	100	0
RI	16	58	0	33	33
T	15	46	0	0	100
TF	8	67	8	100	0
U	0	71	14	0	0
Mean	22	50	7	42	48

Table 8 shows that, on average, only 7 % of the participants already use the API-KCDB, an encouraging further 42 % plan to use it in the future; about half of the participants have not immediate plans in place to use the API-KCDB. Table 8 suggests that only 22 % of the participants feel sufficiently informed about the API-KCDB; 50 % responded to have a need for further information.

This feedback indicates that promotion and training could benefit the use of the API-KCDB in the community.

6.2 Visibility

The visibility of the API-KCDB can be gauged by combining answers on question #4 (roles in the KCDB) and on questions #23, #24 (knowledge and plan to use API-KCDB). Table 9 shows the results. Even though most of the participants play a role in the KCDB (68 % on average), only a minority are informed about the API-KCDB (22 % on average) or used it already (7 % on average). Nevertheless, 42 % of the informed participants declare they will use it in future time.

Table 9: Role in the KCDB (question #4) versus awareness of the API-KCDB (question #23) and plans to make use of it (question #24).

CC	Role in the KCDB / %	'am informed' / %	'used it / %'	'will use it' / %
AUV	74	30	0	22
EM	78	48	4	36
L	57	29	14	50
M	68	43	14	78
PR	91	24	10	0
QM	75	6	6	100
RI	90	16	0	33
T	62	15	0	0
TF	75	8	8	100
U	14	0	14	0
Mean	68	22	7	42

7 Activity level on Digital Transformations

A set of question addressed the current level of activity of the NMIs regarding Digital Transformation. CC members were asked in question #11 whether they planned or are running projects on digital transformations and/or digital calibration certificates.

Table 10 summarized the outcome of this question #11. It reveals that more than half of all CC members have their own projects on digital transformations in place and that the majority of efforts on digital transformation are invested in the area of digital calibration certificates.

Table 10: Digital projects at the CC members based on returns on question #11

CC	Yes, DT projects in place / %	of them DCC typed / %	other types of projects / %
AUV	56	80	■ sensor networks / 7 (1 return) ■ DTX / 7 (1 return)
EM	65	80	■ digital output instrumentation in electrical power network substations / 7 (1 return) ■ digital customer portal, sensor networks, simulation, modelling, AI / 7 (1 return) ■ RDM / 7 (1 return)
L	64	56	■ remote calibration and digital twin / 11 (1 return)
M	50	91	■ laboratory automation / 9 (1 return) ■ RDM / 9 (1 return)
PR	57	58	■ DVC / 8 (1 return)
QM	50	63	■ automation / 13 (1 return)
RI	58	73	■ AI / 9 (1 return)
T	46	100	■ sensor networks / 17 (1 return) ■ automation / 17 (1 return)
TF	58	57	■ digital dashboard / 14 (1 return)
U	57	25	■ machine readable standards / 25 (1 return)
Mean	56	68	sensor networks, RDM, and automation

8 Open comments

At the end of the questionnaire, the participants were given the possibility to provide open comments. The following paragraph summarizes the remarks received.

*'The implementation of **the DCCs will have many advantages** to approach **the SI** to the users, but it will be necessary to **push the users**, accredited laboratories or **the industry**, to move also to the digital transformations.'*

and

*'I recommend **BIPM to closely collaborate** with IEC and ISO in order to provide the society with a **common unique model for the digitization** of measurements.'*

or

'... It is important to include regulators to this process as early as possible.'

With

*'... Relevant **CMCs for digital services** may need to be established.'*

But on the other hand:

*'I am still to be convinced that the **effort required** to integrate our current practices with a **DCC** for example, will **ever be recovered**.'*

and

*'Bespoke/customised **calibration certificates** are proliferating in industry so if a **standardised DCC** is to be established this **needs to be done quickly**.'*

or

*'I think the main issue is **standardization of calibration processes** and results. At the NMI level there is a very **wide range of calibrations certificates for the same artefact** (especially for instrument calibrations rather than passive artefacts). I **doubt if DCCs can actually work unless there is uniformity** of what a calibration certificate should contain for each artefact.*

*I am also **concerned** that this whole field uses **many ill-defined or vague terms and concepts**, and there is a lot of **'hype'** that **hides the true value** of the activity.'*

And

*'**Close collaboration** among the NMIs are important to achieve **impactful outcomes**.'*

Where,

*'This area so **under development** that a **clear view** is really **difficult**. This makes that **answers** are also **difficult and unclear**.'*

as well as

*'**Standardisation** is required for **harmonisation**. Relevant **CMCs for digital services** may **need to be established**.'*

On the questionnaire itself one returned comment was stating

*'I am not sure whether I have **interpreted all questions correctly**. Sometimes I responded "no idea" when the real answer is "we are thinking about it but haven't decided yet".'*

Annex A

An automatically generated summary by MS Forms with all questions is pasted on the following page.

Survey across Consultative Committees on digital transformations

127

Responses

280:18

Average time to complete

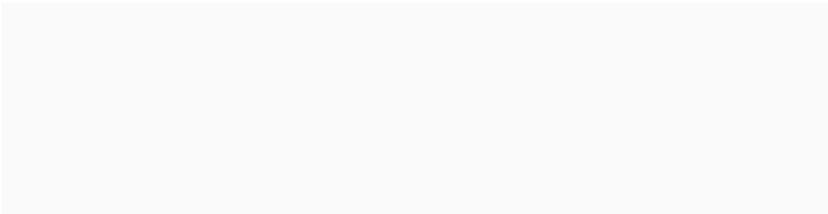
Active

Status

1. Could you please share your name and position in your institution, and your institute's name?

113

Responses

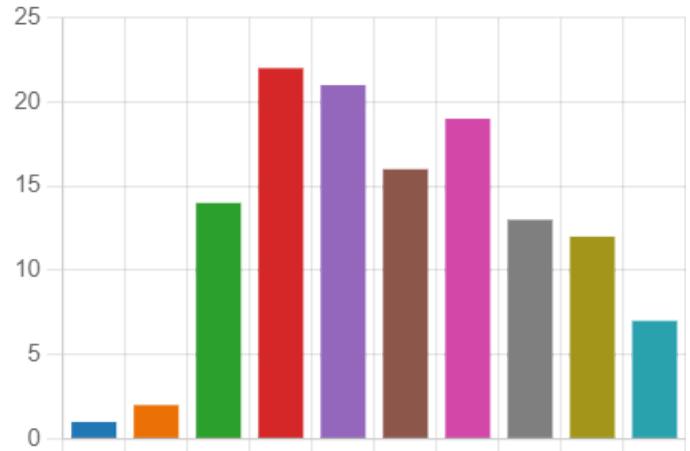


28 respondents (25%) answered **Head** for this question.



2. Could you please specify which CC you are working with

● CCAUV	1
● CCEM	2
● CCL	14
● CCM	22
● CCPR	21
● CCQM	16
● CCRI	19
● CCT	13
● CCTF	12
● CCU	7

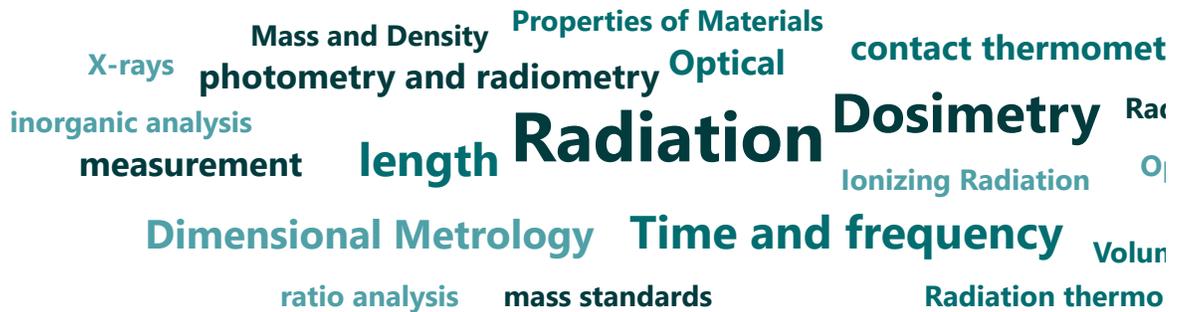


3. In which of your metrology area's subfield are you active?

120
Responses

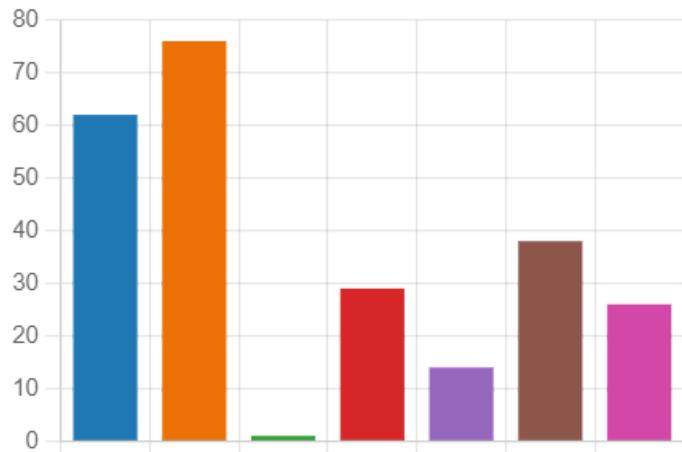
Latest Responses
 "Electricity related areas"
 "EM files "
 "dimensional metrology"

10 respondents (8%) answered **Radiation** for this question.



4. Have you played any of the following roles with respect to the KCDB?

● Writer	62
● Reviewer	76
● RMO Secretary	1
● RMO TC/WG Chair	29
● CC WG Chair	14
● Pilot	38
● none	26



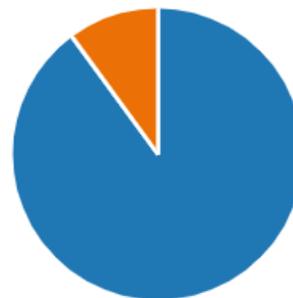
5. Does your work involve:

● research	113
● CIPM MRA activities	88
● customer services	101
● direct industry support activities	69
● other activities	40

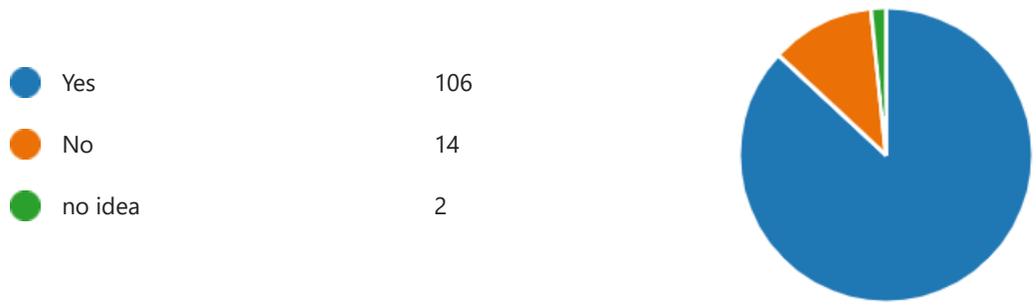


6. If you do customer service or direct industry support activities, are your services backed-up by KCDB-listed CMCs?

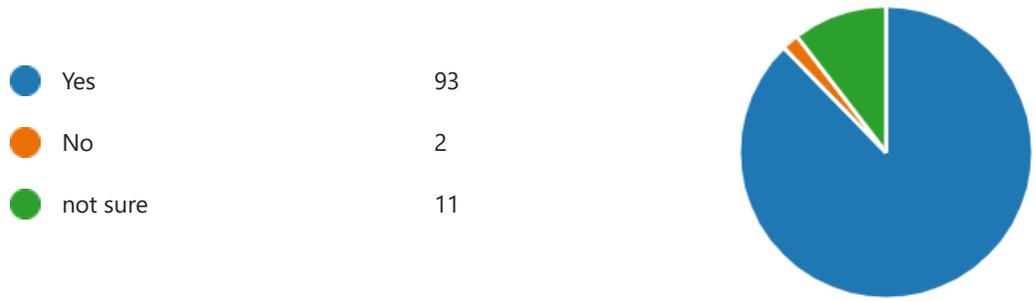
● Yes	107
● No	12



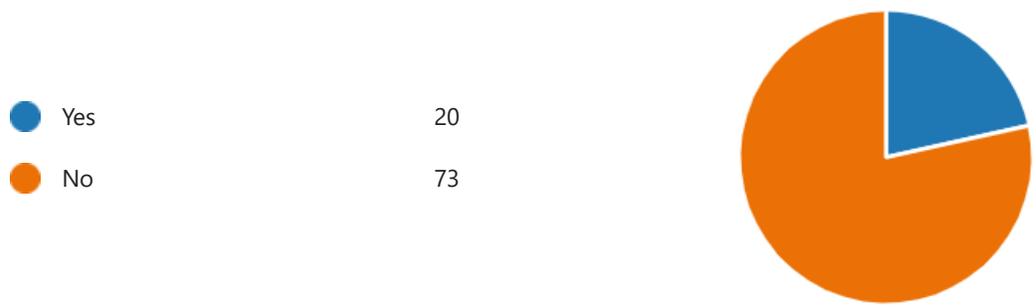
7. Do you have direct contact with stakeholders from industry or otherwise external to your own institution?



8. If yes, are you in a position to recognise your stakeholders' demands and needs?



9. If yes, have you been in a joint project with those stakeholders where digital transformation was one of the topics?



10. If yes, has this project engagement led to own plans to initiate digital services?



11. Is your institute starting or progressing any project on digitalisation and/or a digital calibration certificates (DCC) that are relevant to your CC area? If yes, please describe.

103 Responses

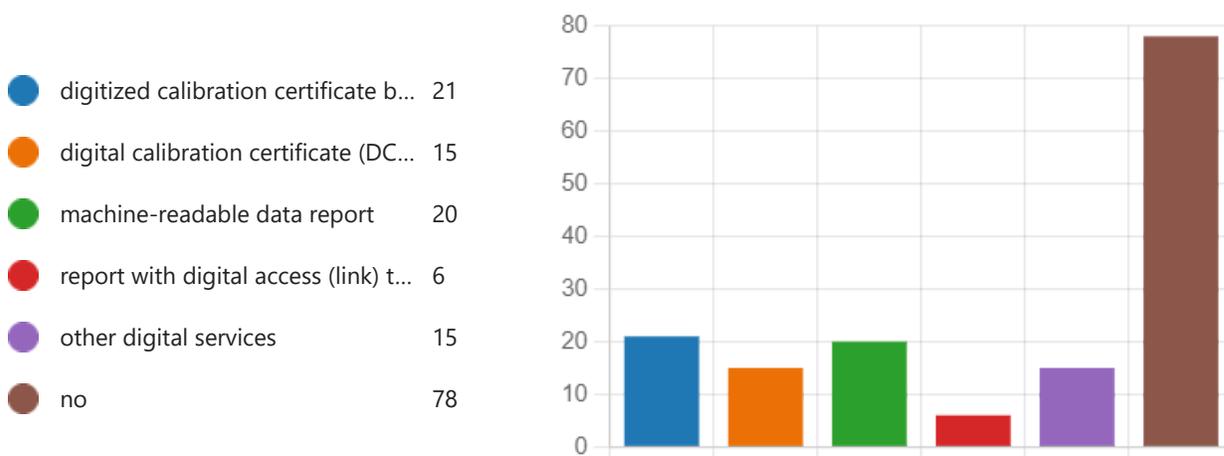
Latest Responses

- "Measurement digitization and XML representation/tagging"
- "Yes, we have started working on DCC BY: 1. Convert any certif..."
- "Development of DCC for CMM and gauge block calibrations a..."

29 respondents (28%) answered **digital** for this question.

Key terms in the word cloud include: digital, DCC, calibration certificate, digital technologies, digital certificates, digital platform, project, working, digital strategy, digital transformation, Digital NMI Certificate of Analysis, measurement s, data, DCCs, DCC developi, digital standards, digi.

12. Have you received any enquiries from customers about digital calibration certificates or digital services and if yes, what were they about?



13. If yes, for which quantity?

45
Responses

Latest Responses

"A large number of IEC standards users expect digital standards"

"NA"

"Evaluation of 3D data evaluation software: Software test of fit ..."

8 respondents (18%) answered **mass** for this question.



14. If yes, which standard did you follow for the format (e.g. format for a DCC, or machine readability)?

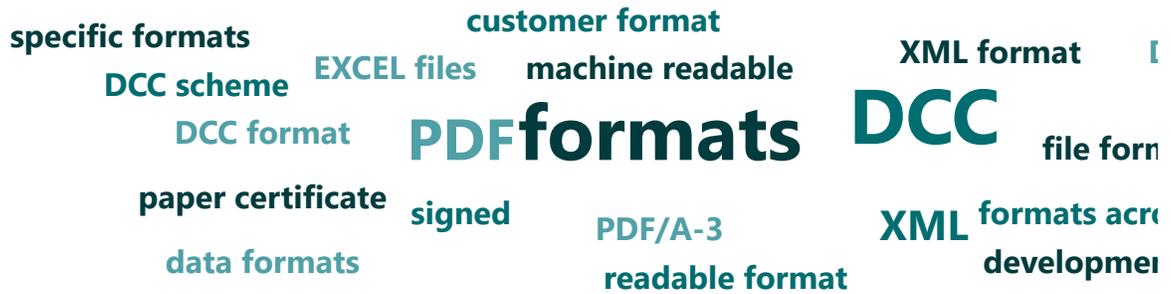
43
Responses

Latest Responses

"We use IEC and ISO standards available, regarding XML, we u...

"DCC"

9 respondents (21%) answered **formats** for this question.



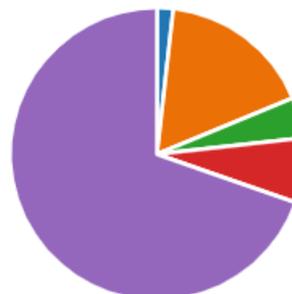
15. If yes, did you collaborate with other NMIs on digital services or digital standards?

- Yes 24
- No 42



16. How often have you received an external request for DCCs/digital services?

- one 2
- a few in the last five years 19
- more than a 5 during the last fiv... 5
- more than a 10 during the last fi... 8
- none 78



17. What type of customers/stakeholder are asking for these digital services in your CC area?

32
Responses

Latest Responses

"Industry standards users and national standardization organiz...

"Discussion in expert forum of accredited calibration laboratori...

11 respondents (34%) answered **calibration laboratories** for this question.



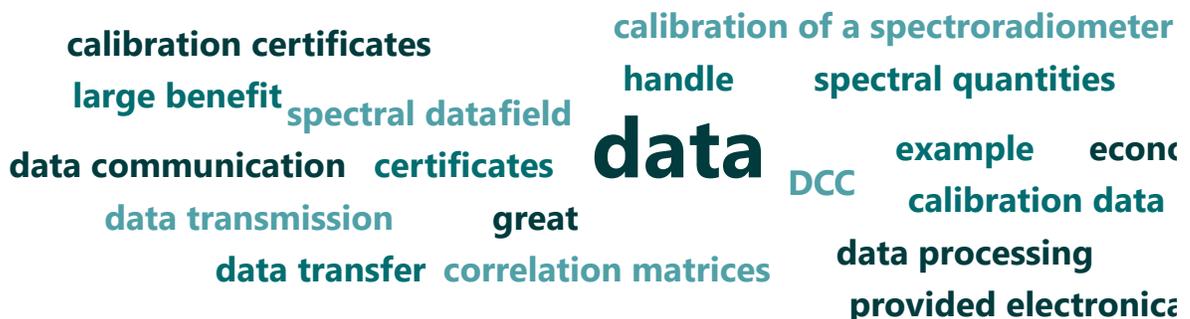
18. Are you aware of any need/use/benefit from a specific subfield of your metrology area for digital calibration certificates and/or the digital SI, if yes, please specify subfield and need?

26
Responses

Latest Responses

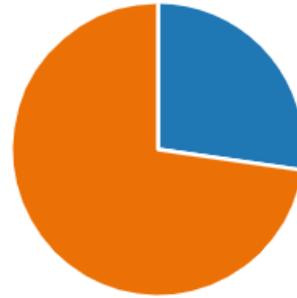
"data communication, IoT."

7 respondents (27%) answered **data** for this question.



19. Do you know about a specific format for an DCC, if yes, please specify the format?

Yes	30
No	80



20. Could you please specify which specific format you are aware of?

30
Responses

Latest Responses
"DCC proposal by PTB (<https://www.ptb.de/dcc/>)"

11 respondents (37%) answered **DCC** for this question.



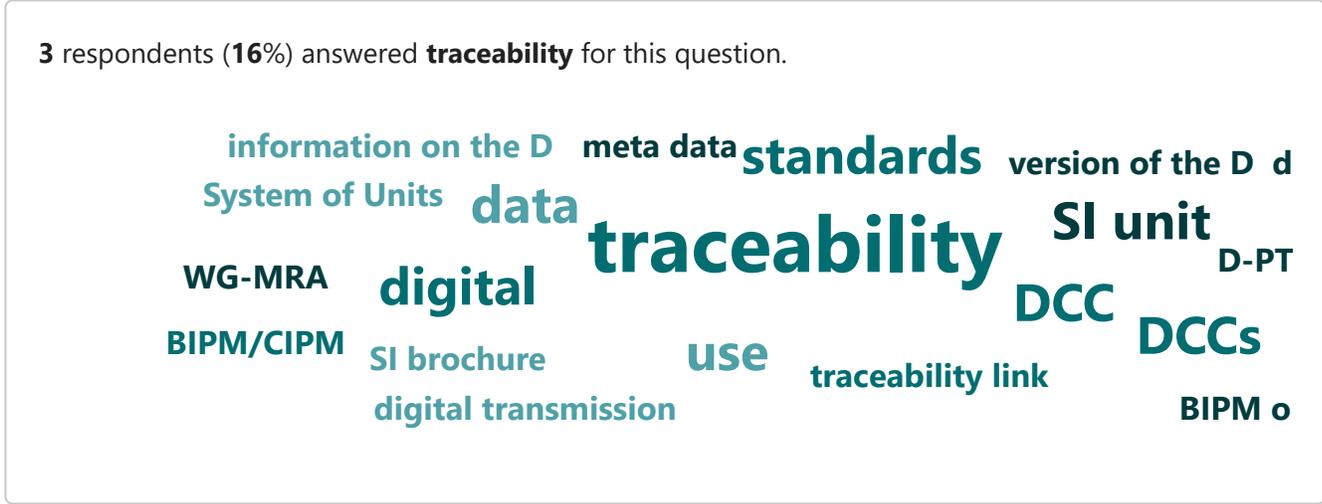
21. If you know about specific DCCs, how would those state their SI traceability and where would they get their traceability from?

19
Responses

Latest Responses

"The SI brochure can be downloaded from <https://www.bipm.or...>

3 respondents (16%) answered **traceability** for this question.



22. If you don't know about specific DCCs, do you think any of your customers would benefit if you were able to issue DCCs; would you be able to improve your services to customers?

● Yes	49
● No	8
● Maybe	47



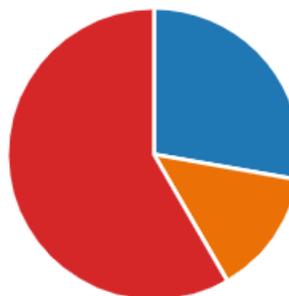
23. What is your status of knowledge about the Application Programming Interface for the KCDB (API-KCDB)?

- I made use of it 11
- I am informed about it 27
- I am interested in it 8
- I would need more information ... 63



24. If you are aware of the API-KCDB, do you plan to make use of it for your CC area

- will use it to retrieve CMC detail... 10
- dedicated plans when issuing o... 5
- other use cases foreseen 0
- no plan yet in place 21

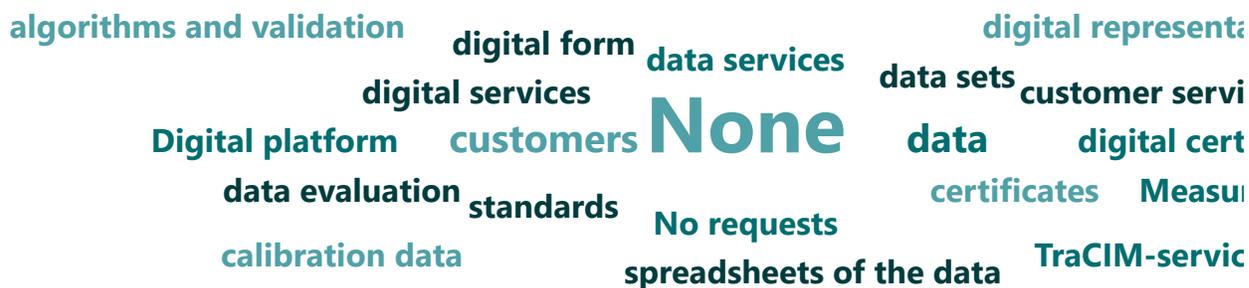


25. Which other digital services are your customers asking for (if any)?

47
Responses

Latest Responses
 "Machine readable standards."
 "Evaluation of 3D data evaluation software: Software test of fit ..."

12 respondents (26%) answered **None** for this question.



26. Has your institute capabilities or intentions to issue calibration services for digital sensors in your CC area?

● Yes	32
● No	38
● no idea	38



27. If yes and concerning digital sensors, are those part of a digital sensor network?

● Yes	7
● No	14
● no idea	11



28. If digital sensors in a digital sensor network are to be calibrated, what procedure could be used to get the whole digital sensor network calibrated?

6
Responses

Latest Responses

2 respondents (33%) answered **traceability dissemination** for this question.



29. What route might be viable to get a customer’s digital sensor network traceable to the SI by means of your institute’s CMC-backed up services?

- no idea 2
- I know there is at least one but I... 0
- we are currently discussing an a... 5



30. Our approach to provide metrological traceability to our digital customer services in my CC area is based on:

56
Responses

Latest Responses
"Needs from the industry, science and metrology."

11 respondents (20%) answered **Digital** for this question.



31. Does your group/team/institute provide metrological services (including classical, analogue ones) to support the digital transformation elsewhere?

● Yes	28
● No	37
● no idea	42



32. We provide metrological support to the digital transformation in:

24
Responses

Latest Responses

5 respondents (21%) answered **industry** for this question.



33. Do you have any comment or anything you would like to highlight to the topic in general or this survey, please leave your statement below:

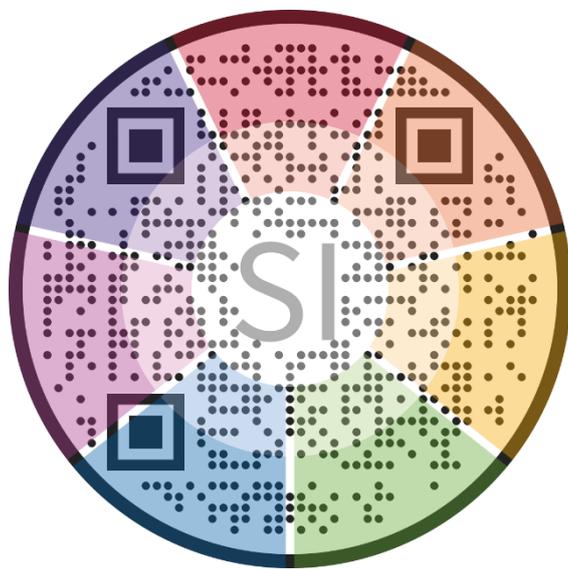
44
Responses

Latest Responses

"IEC is jointly working with ISO on major digitization projects w...

10 respondents (23%) answered **no** for this question.





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