

From calibration results to Machine readable data, DFMs approach

Temadag om digitale kalibreringscertifikater (DCC)
October 5th 2023

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DFM

Danish National Metrology Institute



*DFM receives funding by:
Danish Agency for Institutions and Educational Grants*



DFM A/S

NMI:

Denmark joined the Metre Convention (1875)
DK is therefore obliged to have a National Metrology Institute (NMI), and realizing the SI units.

GTS:

DFM is one of seven Danish GTS institutes, and provides advanced technology services to Danish companies in form of:
calibrations, testing, validation and standardization.
A crossover between academia and industry

DTU:

DFM is 100 % owned by DTU

Staff:

36 people in total, 24 PhDs


DANISH SAFETY TECHNOLOGY AUTHORITY

 **DANAK**

Accreditation:
ISO 17025
ISO 17034

NMI Appointment

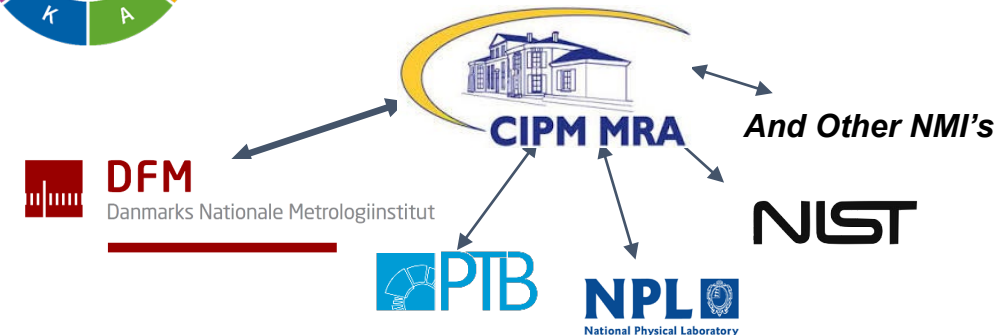
 **DFM**
Danmarks Nationale Metrologiinstitut

**World wide acceptance
of calibration certificates**

*calibration certificates
to companies and
accredited laboratories*



**Ensure
intercomparability**



DFM Calibration services



Nano particles
(size, counters)



Length



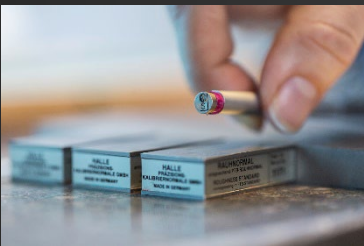
Electricity



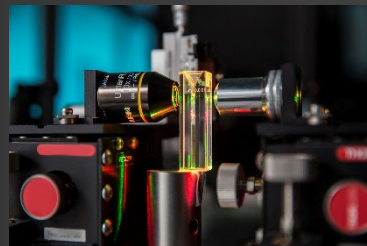
Thermometry
(non-contact)



Mass



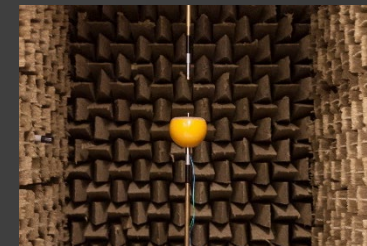
Roughness and
hole plates



Optical
radiometry &
spectro-radiom.



Electro
chemistry



Acoustics



Nano scale

Machine readable Calibration Certificates

DFM's mission: **To support implementation of DCC's that are globally recognized, in order to support efficiency and quality in production companies through automation.**

- Value creation for the customers
 - a. Improved data integrity/safety/**quality** (reduction of human errors)
 - b. Easier transfer/integration to databases
 - c. Efficiency by automation of processes, and streamlining of procedures.
 - d. Easier control and adjustment of measurement equipment
- Primarily relevant to
 - Areas with large numbers of calibrations: Temperature, Pressure, IoT sensors
 - Certificates with large amounts of data: CMM, BRDF, acoustics, ...

Envisioned workflow for DCC'er

Client (NN)

Kal. reminder



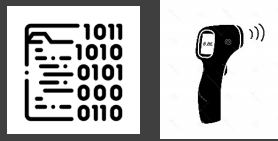
Database



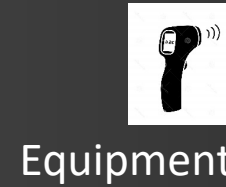
Digital request
Inkl. Specific./
data-template



Digital Tender
& cal. plan



Order &
Equipment



Equipment



DCC
& Invoice

Quality Control
Database
Release of equipment



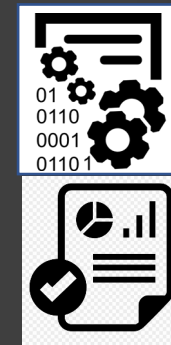
Database



Cal. Lab/NMI



Cal. work



Data og QA



PDF, w/ opt. XMP meta-info,
+ CSV/XML/JSON datafile
+ Hash-sum datafile

Dig. Sign.



Danish pharma requirements for DCC

- A. **Eliminate manual transfer of data from large amounts of certificates.**
- B. **A global standard/Harmonisation:** standard = compliance & efficiency, international standards, data interoperability, data integrity, and **quality**.
- C. **Scalable:** Must be userfriendly for Accr. Cal. Labs to easily adopt.
- D. **Auditable:** being able to identify errors, IT standards e.g. ISO/IEC 27001, ISO 8000, 16175, & common requirements for reporting (ISO-17025).
- E. **Accreditation** should be reliably identifiable in the DCC
- F. **Machine interoperable.**
- G. Preferably be based on PTB's schema work, which has the high recognition in the international metrology community e.g. favoured by NIST, i.e. high likelihood to become a global 'standard'

Client aspect of extracting data from DCC

Often the client only need a few specific informations/data for their QMS in order to release their equipment.

Client database must have registry of:

- All instruments being calibrated.
- what they want to know/extract from a certificate for each instrument.

Instrument Database:



- Cert. No
- Supplier Name
- Equipment Id no.
- Calibration date
- Error Results
- Uncertainty(ies)

Measurement Equipment Specification (MES):

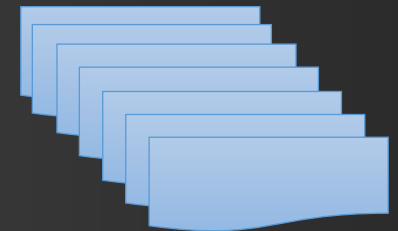
- Applies for similar equipment used for same purpose
- Specifies calibration requirements (Cal. Points, MPEs etc).
- & other info e.g. QA approvals ...
- **Mapping table for Data extraction.**

Incoming

How?



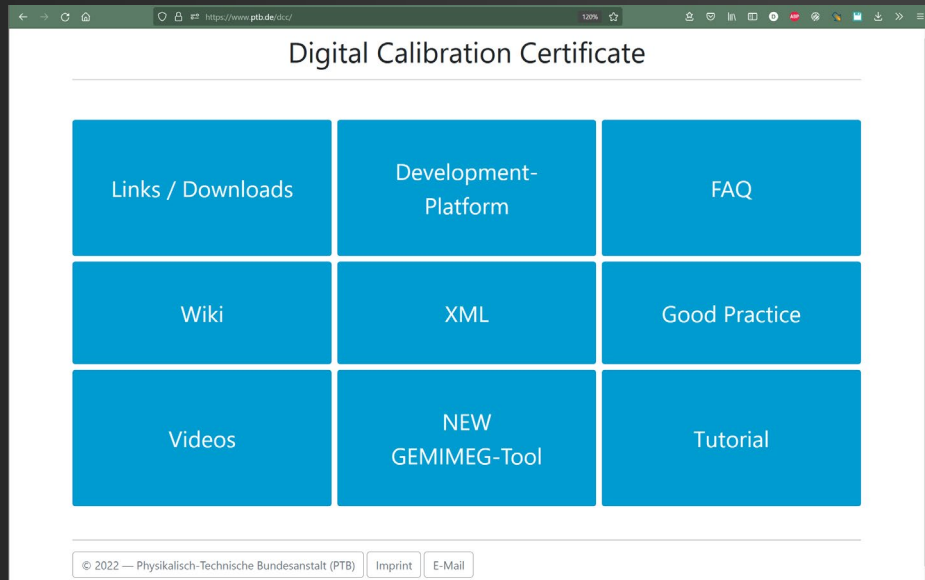
Calibration Task list



PTB's DCC website and documentation: www.ptb.de/dcc

Data types and structure are defined in XML-schema files: [dcc.xsd](#) and [SI_Format.xsd](#).

These are also used for validation of created DCC-xml-files.



The screenshot shows the 'DCC Digital Calibration Certificate - Wiki' page. The page has a blue header with a search bar and a navigation menu on the left. The main content area displays a diagram of the XML schema structure for 'dcc: digitalCalibrationCertificateType'. The diagram shows a root element containing four child elements: 'administrativeData', 'measurementResults', 'comment', and 'document'. Each child element is linked to its corresponding XML Schema Definition (XSD) type. To the right of the diagram, there is a diagram of a target with four rings, labeled 1 through 4, corresponding to the administrative data, measurement results, comments, and document elements respectively. Below the diagram, there is a list of XSD types and a 'LAST EDITED BY' section.

1.: Administrative Data
• regulated

2.: Results of the Calibration
regulated:
 $Y = y \pm U(k) [S]$
not regulated:
- Individual data
- ...

3.: Comments
• not regulated

4.: Document
• human readable

The root element that contains the four rings of the DCC.

administrativeData (Ring 1; mandatory)
The element *administrativeData* contains all essential administrative information about the calibration. The entries in this area are basically the same in all DCCs and are regulated.

measurementResults (Ring 2; mandatory)
In the element *measurementResults*, all information on the results of the measurements on the calibration material are stored. The measurement and result data must have a value and a unit of measurement. Ideally, a (base) SI unit is used as the unit of measurement. The element has at least one child element. The number of further child elements is unrestricted.

Due to the different calibration requirements in the individual areas, the DCCs differ accordingly. It is logical, for example, that DCCs from the field of acoustics differ from those from the field of cyclotron radiation.

comment (Ring 3; optional)
All further information and files agreed between the client and the performing calibration laboratory can be inserted into this element. Files of different file formats (e.g. results from spreadsheet programs) are converted using the Base64 method [1] so that they can be saved in the XML structure. They can then be extracted again from the XML structure and converted back identically into the original data format using the Base64 procedure.

document (Ring 4; optional)
The element *document* contains the human-readable variant of the DCC.

LAST EDITED BY
Lutz Doering
01/06/2022

GEMIMEG Tool

GEMIMĚG v1.0.0

Measurement Results

DE

Create a new DCC or load a existing one

Choose Good Practice Example as a Template

TEMPERATURE | BAROMETER | HUMIDITY

Last loaded Files

- DFM-DCC-Template.xml (Latest autosaved version, 7 days ago)
- dcc_dfm_test.xml (Latest autosaved version, 6 days ago)
- 2022-08-18_GP_Temperature... (Latest autosaved version, 1 day ago)
- 2022-08-18_GP_Barometer.xml (Latest autosaved version, 6 days ago)
- 2022-08-18_GP_Humidity.xml (Latest autosaved version, 6 days ago)

CREATE NEW DCC | LOAD EXISTING DCC

Drop DCC here to load it.

Supported DCC Version: v3.1.2

Attention: This tool is a demonstrator. It should not be used in a production environment.

PREVIOUS STEP | NEXT STEP

GEMIMĚG v1.0.0

Measurement Results

+ ADD NEW MEASUREMENT RESULT

Language selection for datasets: DE | EN | +

Measurement Result 1

Name (de): Messergebnisse

Used Methods

RefType	Name	Description	Actions
basic_uncertainty	Erweiterte Messunsicherheit	Angegeben ist die erweiterte Messun...	[edit] [delete]
gp_uncertainty	Verfahren	Die Messunsicherheit der Abweichun...	[edit] [delete]
gp_method	Kalibrierverfahren	Die Feuchtekalisierung wurde nach d...	[edit] [delete]
gp_measuringConditions	Messbedingungen	Die Kalibrierung wurde in einem Klima...	[edit] [delete]

Measuring Equipments

RefType	Name	Description	Actions
basic_normalUsed	Pt 100 Widerstandsthermometer	-	[edit] [delete]
basic_normalUsed	Taupunktspiegel-Hygrometer	-	[edit] [delete]

Influence Conditions

RefType	Name	Description	Actions
basic_temperature	Umgebungsbedingung Temperatur	-	[edit] [delete]
basic_humidityRelative	Umgebungsbedingung relative Luftfeuchte	-	[edit] [delete]

PREVIOUS STEP | NEXT STEP

Predefinitions are in external documents

PTB
Messen ■ Forschen ■ Wissen

search

BROWSE HOME IMPRINT PRIVACY

Title:	Instructions on how to use the DCC schema to create a digital calibration certificate for weights : Expert Report DKD-E 7-2
Authors:	Members of the Technical Committee Mass and Weighing Instruments of the DKD, Physikalisch-Technische Bundesanstalt (PTB), ISNI: 0000-0002-1140-5252
Contributors:	HostingInstitution: Physikalisch-Technische Bundesanstalt (PTB), ISNI: 0000 0001 2186 1887
Pages:	46
Language:	en
DOI:	10.7795/550.20220419B
Version:	04/2022
Resource Type:	Text / Technical Requirement
Publisher:	Physikalisch-Technische Bundesanstalt (PTB)
Rights:	https://creativecommons.org/licenses/by-nc-nd/3.0/de/ CC by-nc-nd 3.0
Relationships:	IsVariantFormOf: DOI 10.7795/550.20220419A
Dates:	Available: 2022-04-22 Created: 2022-04
File:	Download File (application/zip) 490.55 kB (502327 Bytes) MD5 Checksum: a766826b6bcd0cae1538a68decd07e43 SHA256 Checksum: 88f45bebfbdd1ab9f1097825062d25e4d1fc56f5df6c4a9a56d566e66f583830
Keywords:	DKD Expert Report ; DCC ; digital calibration certificate ; mass ; weight ; XSD ; SI
Abstract:	Advancing digitalisation does also affect the field of calibration. In view of this development and responding to the needs of industry, the digital calibration certificate (DCC) has been developed. The DCC is an XSD schema file that serves as a kind of template for digital calibration certificates for all measurands in XML format. Its implementation therefore requires further, subject-related specifications. To examine potential applications for the mass calibration of weights and weight sets and to determine the related specifications, the DKD Technical Committee Mass and Weighing Instruments has set up a group of experts who have created the present document. This document describes the contents of the digital calibration certificate for mass calibrations of weights and weight sets. The present document refers to version 3.0.0 of the DCC scheme. For implementation, it is recommended to refer to the latest version of the scheme, currently version 3.1.2. This version is completely downward compatible and allows, among other things, improved indication of references. Given the continuous changes in the field of digital certificates, this report can only reflect the current state of discussions - something to be taken into account in any kind of evaluation or referencing. These changes may refer to changes in the schema file or to higher-level specifications such as coordinated refType attributes. The validity of the remaining regulations remains unaffected. Two xml files are attached to the expert report as examples.
Citation:	Expert report DKD-E 7-2 Instructions on how to use the DCC schema to create a digital calibration certificate for weights, Edition 04/2022, Revision 0, Physikalisch-Technische Bundesanstalt, Braunschweig and Berlin. DOI: 10.7795/550.20220419B

	Instructions on how to use the DCC schema to create a digital calibration certificate for weights https://doi.org/10.7795/550.20220419B	DKD-E 7-2	
		Edition:	04/2022
		Revision:	0
		Page:	13 / 46

Main element	Sub-element	Explanation	Sample value
<i>measurementResult</i> (refId: <i>weightABC1234</i>)	<i>name</i>	Name of the result (multilingual text)	Mass calibration Weight ABC1234
	<i>description</i>	Description of the result (multilingual text, optional)	Mass calibration after revision of the piece of weight
	<i>usedMethods</i>	Description of the methods (optional)	see chapter 4.1
	<i>usedSoftware</i>	Description of the evaluation software used (optional)	1 - ∞ <i>software</i> (child elements: <i>name</i> , <i>release</i> , <i>description</i>)
	<i>measuringEquipment</i>	Description of the measuring equipment (optional)	see chapter 4.3
	<i>influenceConditions</i>	Description of measurement results (optional)	see chapter 4.2
	<i>results</i>	Results	see chapter 4.4
	<i>measurementMetaData</i>	Additional information (optional)	see chapter 4.5

Table 4: Example of contents in the element *measurementResult*

List of identified possible *refTypes* especially in the results part (usable in the elements *influenceCondition* – chapter 4.2, *results* – chapter 4.4 und *measurementMetaData* – chapter 4.5):

- *humidity*
- *temperature*
- *airpressure*
- *volume*
- *density*
- *mass*
- *conventionalWeighingValue*
- *min*
- *max*
- *nominalValue* (only to be used in the *result* element)
- *measurementValue* (only to be used in the *result* element)
- *referencedValue*
- *measurementDeviation* (only to be used in the *result* element)
- *meanValue*

4.1 Sub-element *usedMethods*

The element *measurementResult* contains the sub-element *usedMethods* to describe the calibration methods used. This sub-element consists of any number of child elements *usedMethod*; each of these child elements contains a name and a description.

DCC-Good Practice : Enabling machine interpretability?

```
<dcc:quantity refType="basic_referenceValue">
  <dcc:name>
    <dcc:content lang="de">Bezugswert</dcc:content>
    <dcc:content lang="en">Reference value</dcc:content>
  </dcc:name>
  <si:hybrid>
    <si:realListXMLList>
      <si:valueXMLList>306.248 373.121 448.253 523.319 593.154</si:valueXMLList>
      <si:unitXMLList>\kelvin</si:unitXMLList>
    </si:realListXMLList>
    <si:realListXMLList>
      <si:valueXMLList>33.098 99.971 175.103 250.169 320.004</si:valueXMLList>
      <si:unitXMLList>\degrecelsius</si:unitXMLList>
    </si:realListXMLList>
  </si:hybrid>
  <dcc:measurementMetaData>
    <dcc:metaData refType="basic_calibrationValue">
      <dcc:declaration>
        <dcc:content lang="de">Kalibrierpunkt</dcc:content>
        <dcc:content lang="en">Calibration value</dcc:content>
      </dcc:declaration>
      <dcc:data>
        <dcc:quantity>
          <si:hybrid>
            <si:realListXMLList>
              <si:valueXMLList>306 373 448 523 593</si:valueXMLList>
              <si:unitXMLList>\kelvin</si:unitXMLList>
            </si:realListXMLList>
            <si:realListXMLList>
              <si:valueXMLList>32.85 99.85 174.85 249.85 319.85</si:valueXMLList>
              <si:unitXMLList>\degrecelsius</si:unitXMLList>
            </si:realListXMLList>
          </si:hybrid>
        </dcc:quantity>
      </dcc:data>
    </dcc:metaData>
  </dcc:measurementMetaData>
</dcc:quantity>
```

Special attributes for defining the content, and protocols for data arrangement.

Language support

Calibration data in different units



Interpretation integrity of queried data

Xpath is the common tool for querying xml's, but it is weaknesses.

- **Complexity**: Challenging to understand, especially when dealing with nested structures. **Writing and debugging becomes time-consuming and error-prone.**
- **Fragile**: sensitive to changes in the document structure or layout. **Even minor modifications can cause failure.**

```
/dcc:digitalCalibrationCertificate/dcc:measurementResults/dcc:measurementResult/dcc:results/dcc:result[1]/dcc:data/dcc:list/dcc:quantity[2]/si:hybrid/si:realListXMLList[2]/si:valueXMLList
```

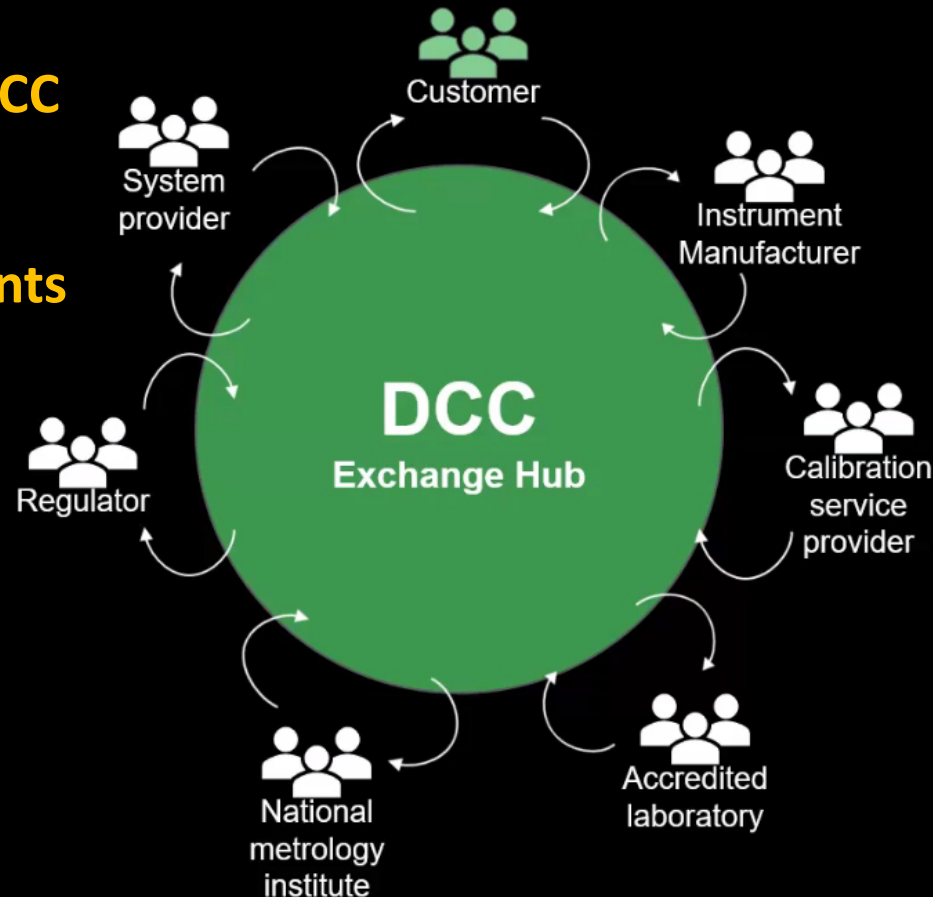
```
/dcc:digitalCalibrationCertificate/dcc:measurementResults/dcc:measurementResult/dcc:results/dcc:result[1]/dcc:data/dcc:list/dcc:quantity[2]/si:hybrid/si:realListXMLList[2]/si:expandedUncXMLList/si:uncertaintyXMLList
```

Scalability

beamex

DCC's needs to solve a many-to-many data transfer problem.

Requirements for DCC exchange system is comparable to the interface requirements for a relational database.

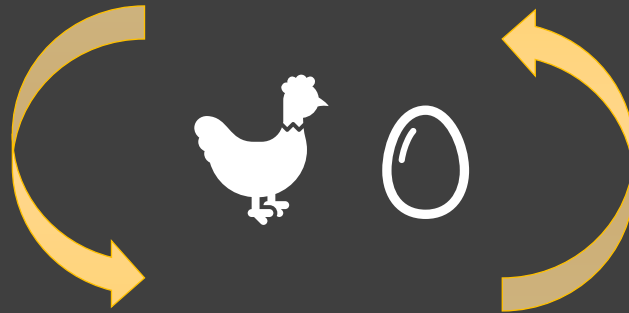


Databases (e.g. SQL) are most commonly designed as relational structures rather than Hierarchical structures

Main challenge

Extraction of data from DCC

- *How to identify what data that is available*
- *How to extract the data relevant to the user*



- *How does the DCC structure best support that data is findable and extractable.*
- *How easy is it for the cal.lab. to adjust for different orders.*

Structure of the DCC

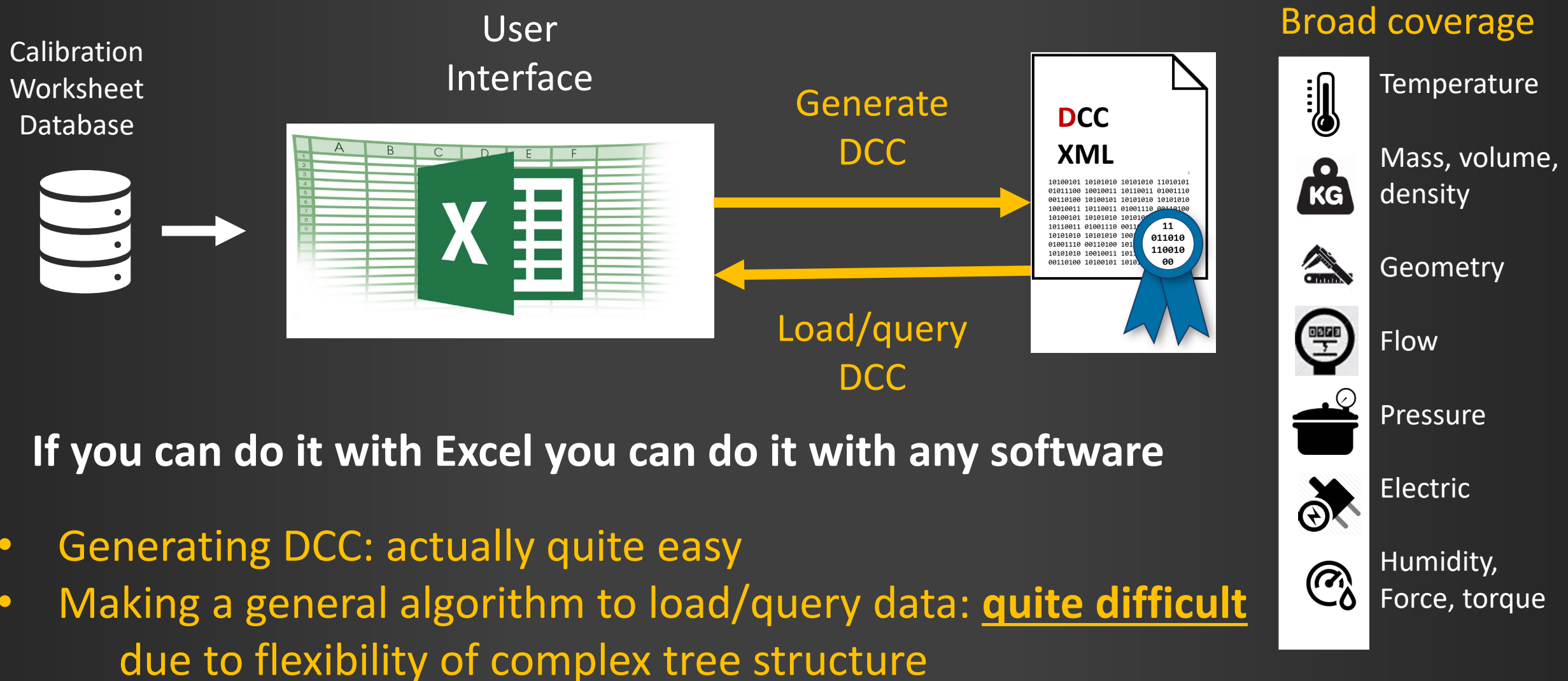
- **Restrictive structure ->**
 - *The structure cannot support all scenarios and customer requests.*



- **Flexible structure ->**
 - *Lots of implementation at the customer end to ensure valid extraction of data.*
 - *The Cal. Lab. has to support too many customer requirements.*
 - *Potential loss of data integrity*

A Restrictive Harmonized Protocol / Standard is needed

Our own basic need in order to work with DCC:

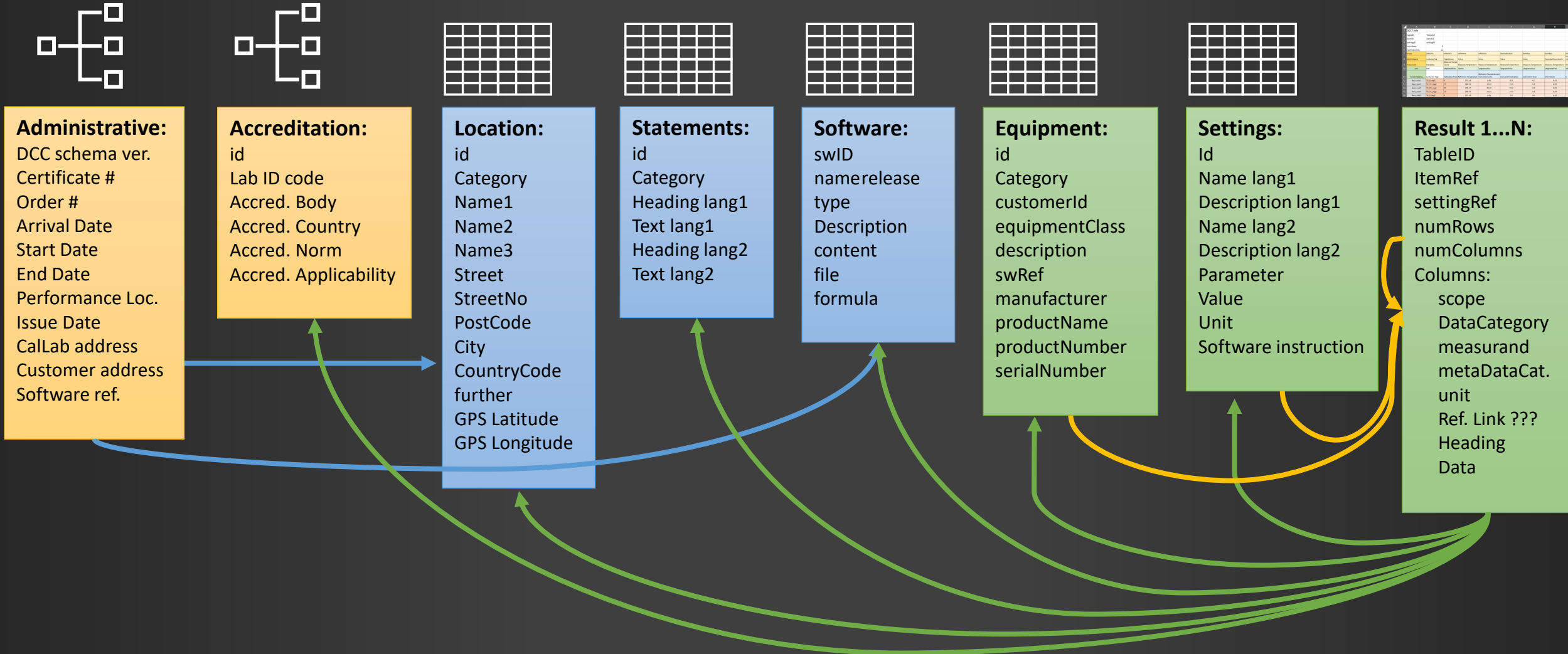


Relational database architecture applied to DCC

As in a relational database – the data is structured into tables with predefined columns.

All row entries in the tables have unique identifiers – which can be reference /linkedto as required or needed.

Id's in the equipment, settings and results, are agreed with client and needed as parameters when doing a data lookup.



Proposal to introduce new attribute types

At the int. DCC conference 2023 DFM recommended to split **refId** and **refTypes** into more specific types. We investigated this and came up with the following attribute splitting:

- **tableID**: This is equivalent to a resultID. It could be a product id by the cal.lab. or be assigned by customer.
- **itemRef**: This refers to the item being calibrated/testet.
- **settingsRef**: This refers to the setttings being applied on the item being calibrated/testet.
- **metaDataCategory**: Distinguish Data and Metadata
- **scope**: Specifies what the Information is about : item, reference, itemBias (relation btw. item & reference), datainfo
- **dataCategory**: Value, TargetValue, ExpandedUncertainty, ..., accreditationApplies, Other
- **measurand**: Defines what kind of physical property is measured (a finite list e.g. using BIPM service categories or NSCLI-MII)
- **unit**: e.g. \kelvin, \kilogram, \metre, ...
- **row**: index to point to a specific datapoint in the array.

A. All 9 attributes has a finite set of predefined possible values, defined either by users or by schema (last 4 types)

B. Constitutes a finite set of query options:

(TableID, ItemRef, SettingsRef, MeataDataCategory, scope, dataCategory, measurand, unit, row)

C. Any combination attribute-parameter values is unique and provides:

- A. a relation between entities in DCC as well as
- B. a unique location of where to find the data.
- C. The XML tree depth is fixed for each of the parameters

Finite options for attribute values are predefined in the Schema:

metaDataType

Data
UsedReferenceId
UsedMethodId
UsedEquipmentId
customerTag
laboratoryTag
accreditationException
TimeStamp
Exception
Statement

scopeTypes

-
reference
itemIndication
itemBias
environment

dataCategoryType

-
Value
TargetValue
ToleranceLimitUpper
ToleranceLimitUpper
AcceptanceLimitUpper
AcceptanceLimitUpper
Conformity
repeatability
Other
accreditationApplies
ExpandedUncertainty
UncertaintyCoverageFactor_k
UncertaintyCoverageProbability

measurandType

-
Measure.Conductance
Measure.Conductivity
Measure.Current.AC
Measure.Current.AC.Sinewave
Measure.Current.AC.Squarewave
Measure.Current.AC.Trianglewave
Measure.Current.DC
Measure.Density.Mass.Gas
Measure.Density.Mass.Liquid
Measure.Density.Mass.Solid
Measure.Force
Measure.Humidity.Absolute
Measure.Humidity.Relative
Measure.Frequency
...

Demo 1 – An Excel User Interface

- `search(TempCal, itemID1, settings01, reference, Value, temperature, \kelvin, T3_15_degC) -> 288.16`
- `search(TempCal, itemID1, settings01, itemBias, ExpandedUncertainty, temperature, \degreecelcius, T3_15_degC) -> 0.05`
- `search(TempCal, itemID1, settings01, itemBias, itemIndication, temperature, \degreecelcius, T3_25_degC) -> 25.2`

	A	B	C	D	E	F	G	H
1	DCCTable							
2	tableID	TempCal						
3	itemID	itemID1						
4	settingID	setting01						
5	numRows	5						
6	numColumns	12						
7	scope	dataInfo	reference	reference	reference	itemIndication	itemBias	itemBias
8	dataCategory	customerTag	TargetValue	Value	Value	Value	Value	ExpandedUncertainty
9	measurand	metaData	Measure.Temperature	Measure.Temperature	Measure.Temperature	Measure.Temperature	Measure.Temperature	Measure.Temperature
10	unit	nan	\degreecelcius	\kelvin	\degreecelcius	\degreecelcius	\degreecelcius	\degreecelcius
11	humanHeading	Customer Tags	Calibration Point	Reference Temperature	Reference Temperature in instrument units	Instrument indication	Instrument Error	Uncertainty
12	data_row1	T0_0_degC	0	273.16	0.01	-0.1	-0.1	0.05
13	data_row2	T1_15_degC	15	288.16	15.01	15.1	0.1	0.05
14	data_row3	T2_25_degC	25	298.17	25.02	25.2	0.2	0.05
15	data_row4	T3_15_degC	15	288.16	15.01	15.3	0.3	0.05
16	data_row5	T4_0_degC	0	273.16	0.01	0.0	0.0	0.05

Client aspect of extracting data from DCC

Instrument Database:

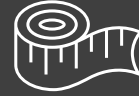


- Cert. No
- Supplier Name
- Equipment Id no.
- Calibration date
- Error Results
- Uncertainty(ies)

DCR generated by client

Table: tableId=nn125 refId=item2							
dcc:column		columns					
Sub elements	Column attributes	main	main	main	main	main	main
metaType	main	CalibrationPoint	referenceResult	referenceResult	referenceResult	DUTIndication	DUTBias
colType	customerTag	referenceResult	temperatureAbsolute	temperatureAbsolute	temperatureAbsolute	temperatureAbsolute	temperatureDifference
measurandType	identification	temperatureAbsolute	temperatureAbsolute	temperatureAbsolute	temperatureAbsolute	temperatureAbsolute	temperatureDifference
dcc:heading		Calibration Point	Reference Temperature	Reference Temperature in Instrument units	Instrument Indication	Instrument Error	
si:unit		\degreeCelsius	Kelvin	\degreeCelsius	\degreeCelsius	\degreeCelsius	\degreeCelsius
XMLList		T0_degC	0				
		T1_15_degC	15				
		T2_25_degC	25				
		T3_15_degC	15				
		T4_0_degC	0				

DCR send to Cal. Lab.



DCC generated Cal. Lab.

Table: tableId=nn125 refId=item2							
dcc:column		columns					
Sub elements	Column attributes	main	main	main	main	main	main
metaType	main	CalibrationPoint	referenceResult	referenceResult	referenceResult	DUTIndication	DUTBias
colType	customerTag	referenceResult	temperatureAbsolute	temperatureAbsolute	temperatureAbsolute	temperatureAbsolute	temperatureDifference
measurandType	identification	temperatureAbsolute	temperatureAbsolute	temperatureAbsolute	temperatureAbsolute	temperatureAbsolute	temperatureDifference
dcc:heading		Calibration Point	Reference Temperature	Reference Temperature in Instrument units	Instrument Indication	Instrument Error	
si:unit		\degreeCelsius	Kelvin	\degreeCelsius	\degreeCelsius	\degreeCelsius	\degreeCelsius
XMLList		T0_degC	0	273.16	0.01	-0.1	-0.1
		T1_15_degC	15	288.16	15.01	15.1	0.1
		T2_25_degC	25	298.17	25.02	25.2	0.2
		T3_15_degC	15	288.16	15.01	15.2	0.2
		T4_0_degC	0	273.16	0.01	0.0	0.0



Mapping table

DB_ID	DCC_LOC
Cert. No	XPath1/...
Meas.val.	XPath2/...
Equip. ID	XPath3/...
Result1	TableID,itemID, scope, category, measurand, unit, (row)
Uncert1	TableID, itemID, scope, category, measurand, unit, (row)

DCC Send to Client



Mapping is used to import data from DCC

- Cert. No
- Supplier Name
- Equipment Id no.
- Calibration date
- Error Results
- Uncertainty(ies)

Instrument Database:



Implementation is available:

[https://github.com/
TC-IM-1448/DCC-Tables](https://github.com/TC-IM-1448/DCC-Tables)

dcc.xsd - Schema file.

3 python files implementing

- the necessary functions to interface with Excel
- A python API to query data from DCC's

The screenshot shows the GitHub repository page for 'TC-IM-1448 / DCC-Tables'. The repository is public and has 2 branches and 0 tags. The commit history shows a recent update to README.md by DavidBalslevHarderDFM. The file list includes Examples, DCC_template.xlsx, DCChelpfunctions.py, README.md, dcc.xsd, dcc2excel.py, and excel2dcc.py. The README.md file is open, showing the repository title 'DCC-Tables' and a description: 'This repository represents a solution for Digital Calibration Certificates (DCC) based on'.

TC-IM-1448 / DCC-Tables

Code Issues Pull requests Actions Projects Wiki Security

DCC-Tables Public Edit Pins Watch

main 2 branches 0 tags Go to file Add file Code

DavidBalslevHarderDFM Update README.md 4cdaa2b 3 days ago 96 commits

Examples	Added BIPM service categories.	last week
DCC_template.xlsx	Remove DCR-example	last week
DCChelpfunctions.py	Search function updated with wildcards -	last week
README.md	Update README.md	3 days ago
dcc.xsd	use x in first column of worksheet to include in dcc	last week
dcc2excel.py	Search function updated with wildcards -	last week
excel2dcc.py	Search function updated with wildcards -	last week

README.md

DCC-Tables

This repository represents a solution for Digital Calibration Certificates (DCC) based on

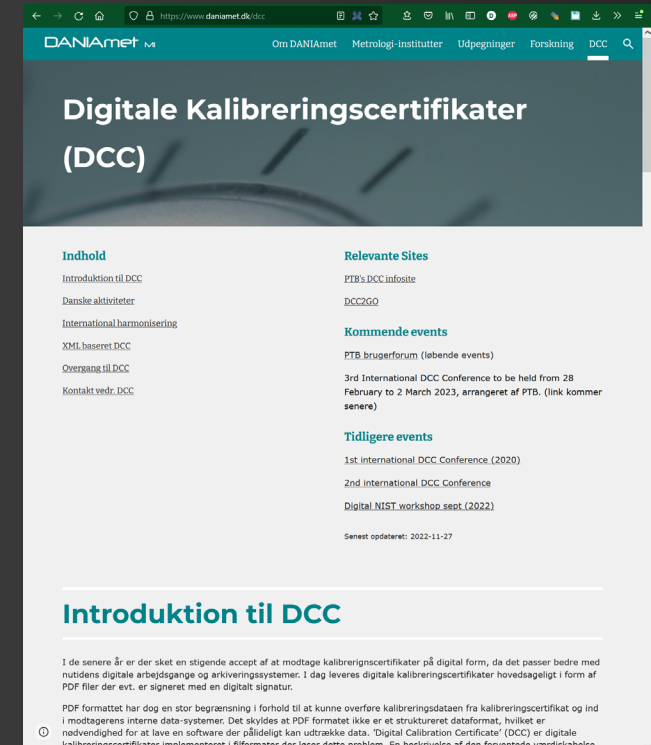
Next steps

International Harmonisation discussed in EURAMET Project TC-IM 1448 WP1.

Testing of DCC Tables and comparison to DCC 3.X is initiating this autumn. In collaborations between DFM, DTI FORCE Technology and Danish pharma-industry (Novo Nordisk) as well as accredited labs e.g. DANDIAG (pipettes).

DCC2GO: <https://github.com/DCC2GO-Project>

Keep updated on the danish webpage to coordinate and disseminate information about DCC to Danish stakeholders.



www.daniamet.dk/dcc

Thank You

To TI for hosting today's event.

To Danish collaborators, TI, FORCE, Novo Nordisk, DANDIAG etc.

To International collaborators at PTB, TC-IM 1448, DCC2GO and other fora.

To audience for listening.

Contact: David Balslev-Harder (dbh@dfm.dk)