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Calculation model to compare different proficiency tests –

Modello di calcolo per la comparazione dei proficiency tests

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Werner Luginbühl (ChemStat)

AEOS ANALYTICA 2019, Roma, 21 March 2019

Topics

- Introduction
- What could happen today?
- SCC Reference System

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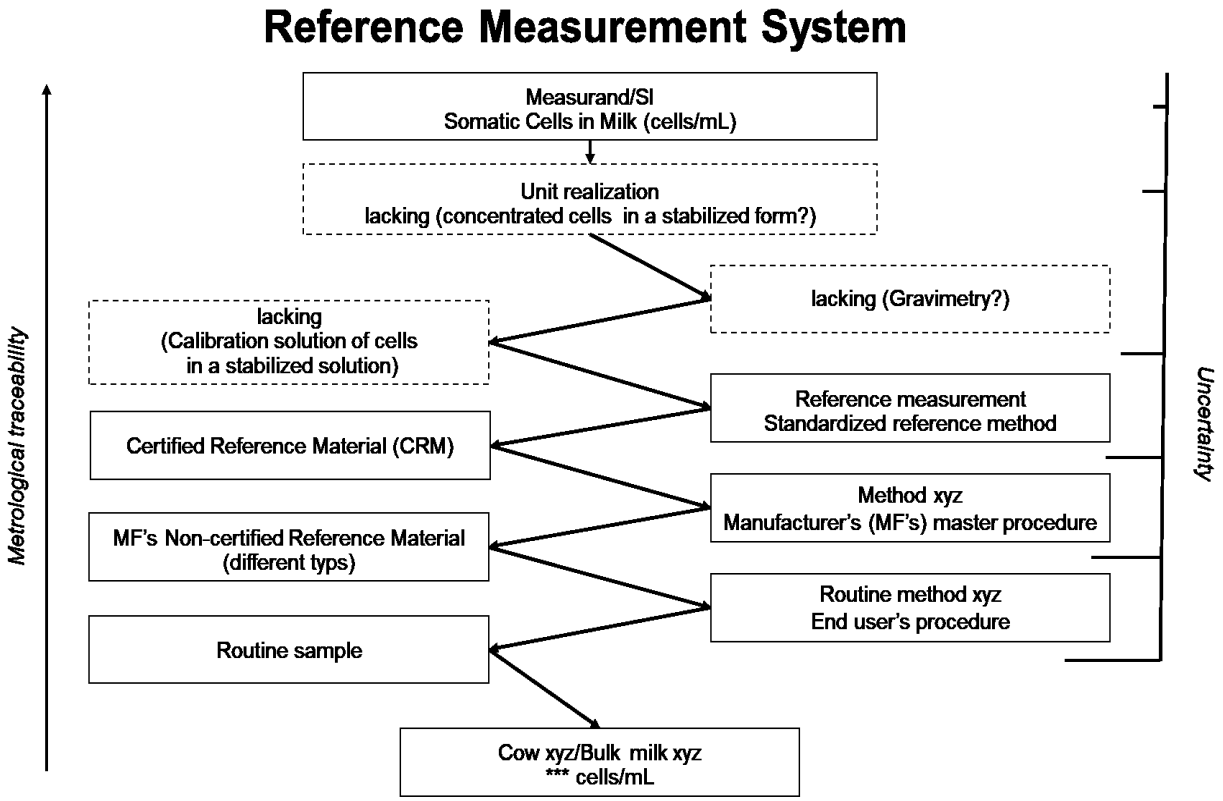
Introduction

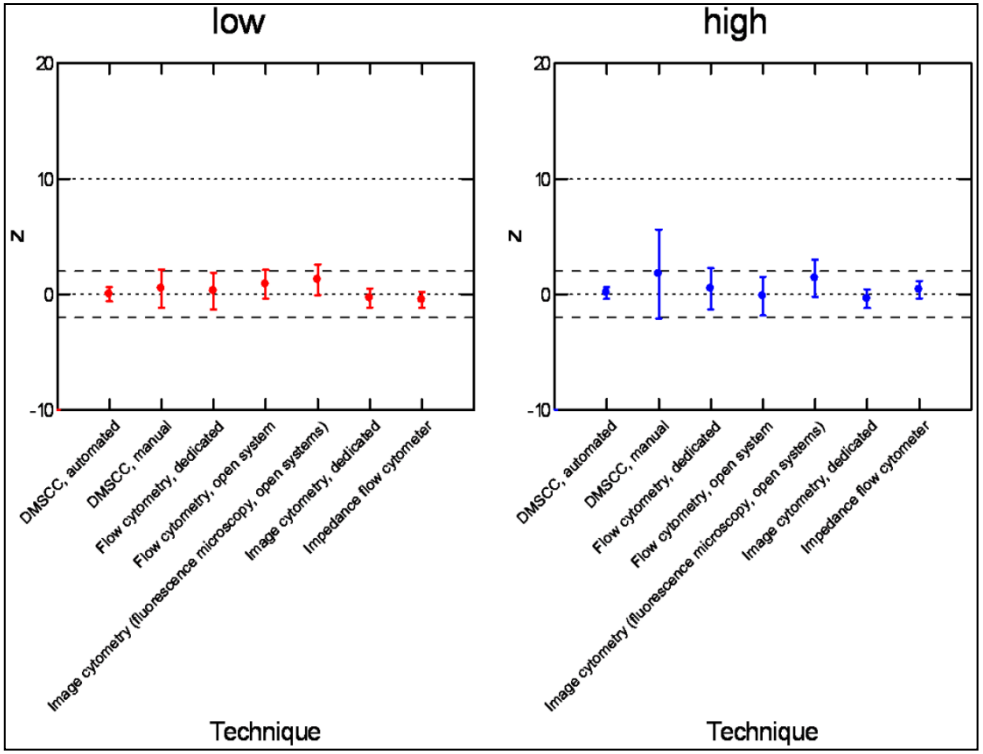
What is normal in metrology?



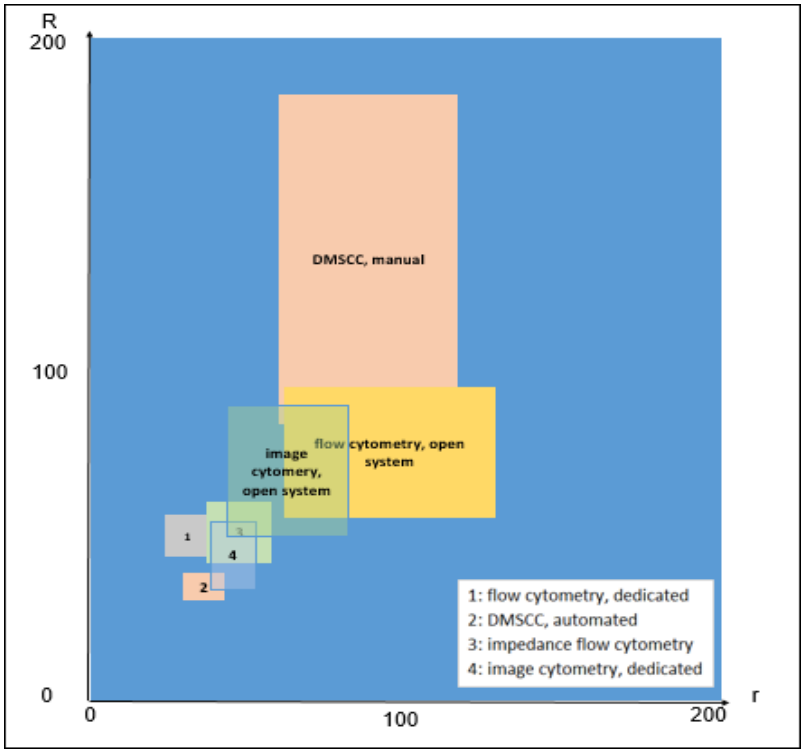
Reference measurement system for Somatic Cell Counting in milk
as proposed in draft IDF Bulletin "Inventory, Evaluation, and Perspectives on methods for determination of SCC", Berger T. and Schwarz D., 2019

Introduction

What about the reference method?



z-values per type of method and standard level using data of the feasibility study conducted in the framework of IDF Action Team S15
Draft IDF Bulletin "Inventory, Evaluation, and Perspectives on methods for determination of SCC", Berger T. and Schwarz D., 2019



Graphical comparison of the methods using repeatability and reproducibility data of the feasibility study conducted in the framework of IDF Action Team S15
Draft IDF Bulletin "Inventory, Evaluation, and Perspectives on methods for determination of SCC", Berger T. and Schwarz D., 2019

Introduction

What is the case in SCC measurement?

-

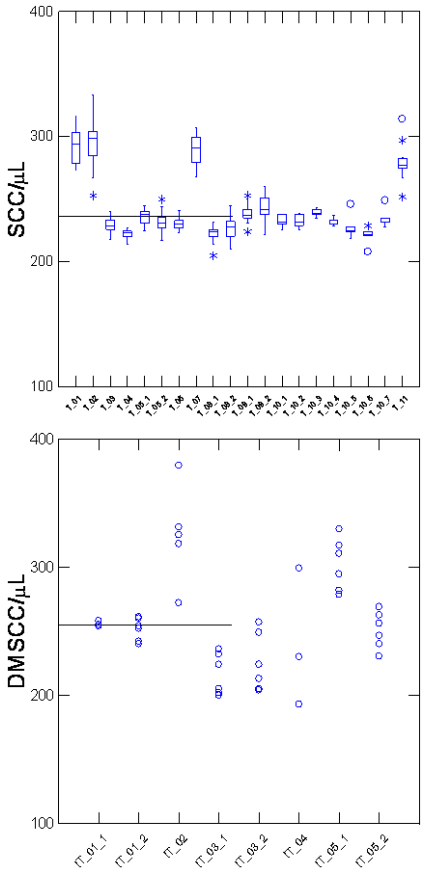
- The current reference method is based on microscopy, has been described as tedious, cumbersome, and challenging to work with
- It is a defining method, a method which determines a value that can only be arrived at in terms of the method per se and serves by definition as the only method for establishing the accepted value of the item measured (CODEX, 2018): what an individual operator counts are somatic cells → it's the microscopist's decision!
- The feasibility study performed in the framework of IDF AT15 revealed that the current reference method is not fit for purpose [.. but the search for alternative methods has started]
- No certified reference material (CRM) [..but the certification study started]

+

- Sufficiently good routine method
- Different proficiency testings (PTs) and secondary/working standards with a certain variability in measurand, concentration and matrix

Introduction

…and what happens because of that?



Graphs: Characterization of Agroscope Somatic Cell Count Standard January 2014, Liebefeld 16.04.2014

- Generally a good comparability in routine measurements of labs from different countries and networks
- Generally comparable links to other proficiency testings

but..

- Insufficient traceability because of a lacking CRM and a reference method not fit for purpose
- Sometimes ”islands” of labs show up indicating
  - weaknesses in the system
  - that some efforts are needed to make the system comparable
- ..and sometimes the uncomfortable feeling that we deal with a Zanzibar effect

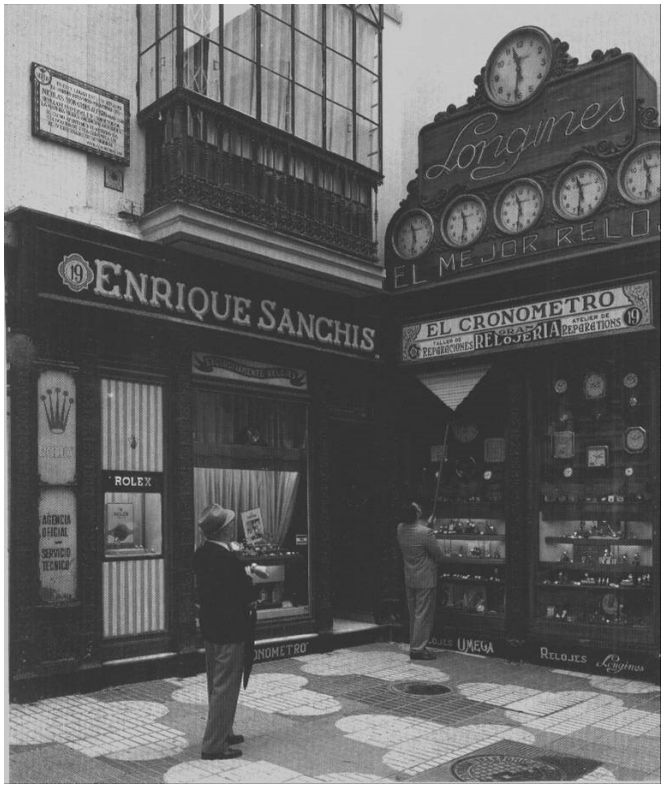
What could happen today?

Circular traceability

Zanzibar effect

The famous story of the retired sea-captain on the island who takes his time from the watchmaker in town only to find out that the watchmaker uses the sea-captain's cannon shots at 12 noon each day to set his own clocks!

(Examples of this kind of circular traceability in measurement are more common than one would hope.)

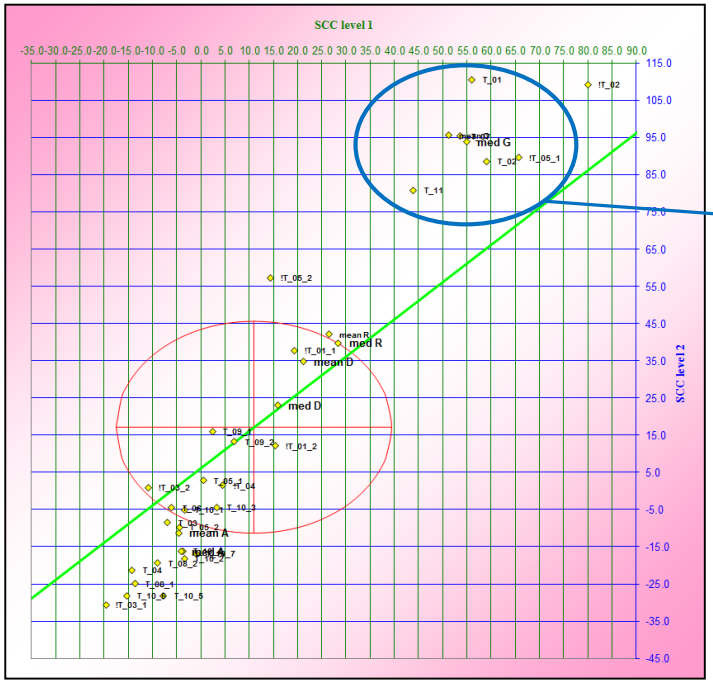


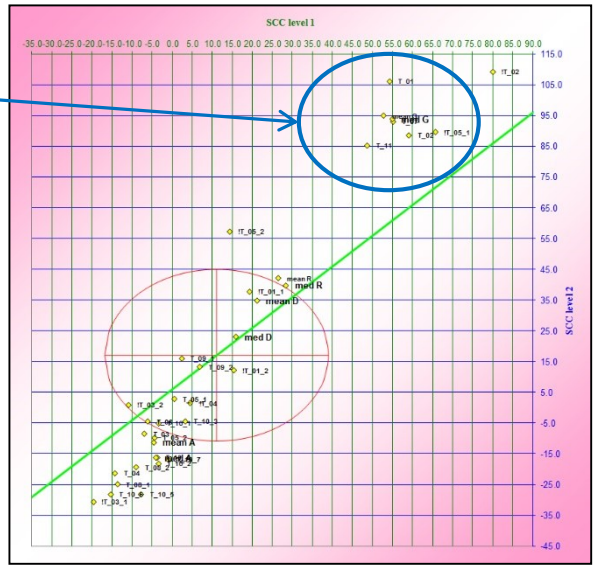
Source: L. Pendrill, Attributed to Harrison (MIT) by Petley, Applications of Statistics in Measurement & Testing (*http://metrology.wordpress.com/statistical-methods-index/basic-theory-of-measurement-and-error/trueness-%E2%80%93-calibration-and-traceability/*)

What could happen today?

Focus on subgroup criteria

- Labs of a subgroup (country, organization, method/equipment) want to improve and focus on subgroup criteria
  - PT my be influenced moderatly
  - Labs of the subgroup move away from the general mean





SCC Reference System

What is a Reference System?

- A statistical approach for the comparability of PTs and of participating laboratories
- Using a Quality Index P_L to evaluate the analytical performance of laboratories and a Quality Index P_Q to evaluate PTs both deriving from probabilities
- The approach is making use of the precision parameters as reported in the international standard ISO 13366-2 and of assigned values of test materials

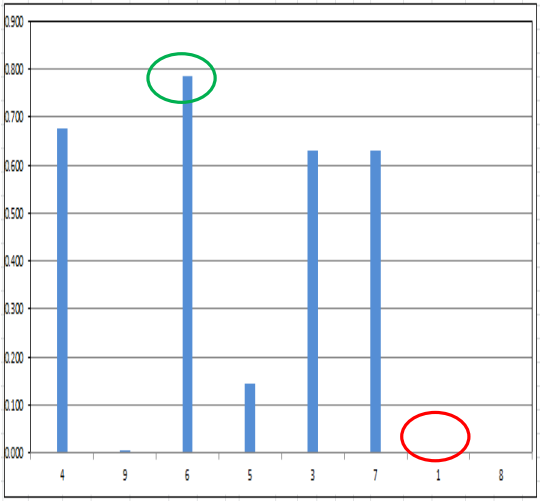
see also: *Berger T.F.H., Luginbühl W. 2016. Probabilistic Comparison and Assessment of Proficiency Testing Schemes and Laboratories in the Somatic Cell Count of Raw Milk. Accred Qual Assur, 21, 3, 175–183* (https://link.springer.com/article/10.1007/s00769-016-1207-y)

SCC Reference System

What are the influencing parameters?

Parameters influencing P_L

s_r	$\bar{y}$	θ	σ_r	σ_R	n	$\tilde{Z}_n$	q_1	q_2	q_3	q_4	q_5	q	q(w)	$\hat{\chi}^2_{(r)}$	$P_{(r)}$	$P(\tilde{z}_n)$	P_L	$\tilde{P}_L$
0.00	269.00	261.00	13.73	21.56	2	0.416	1	1	1	1	1	1.0000	1.000	0.000	1.000	0.678	0.678	0.2357
0.71	207.50	261.00	13.73	21.56	2	-2.779	1	1	1	1	1	1.0000	1.000	0.003	0.959	0.005	0.005	0.0018
2.12	263.50	261.00	13.73	21.56	2	0.130	1	1	1	1	1	1.0000	1.000	0.024	0.877	0.897	0.787	0.2736
4.95	236.50	261.00	13.73	21.56	2	-1.273	1	1	1	1	1	1.0000	1.000	0.130	0.718	0.203	0.146	0.0508
6.36	261.50	261.00	13.73	21.56	2	0.026	1	1	1	1	1	1.0000	1.000	0.215	0.643	0.979	0.630	0.2191
6.36	261.50	261.00	13.73	21.56	2	0.026	1	1	1	1	1	1.0000	1.000	0.215	0.643	0.979	0.630	0.2191
56.57	283.00	261.00	13.73	21.56	2	1.143	1	1	1	1	1	1.0000	1.000	16.976	0.000	0.253	0.000	0.0000
85.56	305.50	261.00	13.73	21.56	2	2.312	1	1	1	1	1	1.0000	1.000	38.833	0.000	0.021	0.000	0.0000



$S_r < \sigma_r \rightarrow P_r$ high

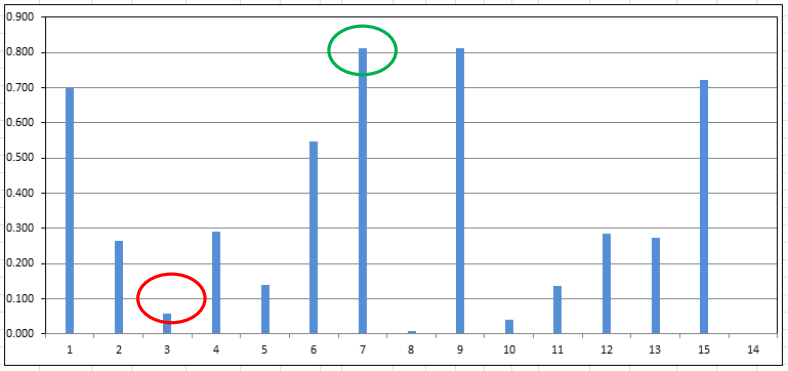
$S_r > \sigma_r \rightarrow P_r$ low

SCC Reference System

What are the influencing parameters?

Parameters influencing P_L

s_r	$\bar{y}$	θ	σ_r	σ_R	n	$\tilde{z}_n$	q_1	q_2	q_3	q_4	q_5	q	q(w)	$\hat{\chi}^2_{(r)}$	$P_{(r)}$	$P(\tilde{z}_n)$	P_L	$\tilde{P}_L$
0.00	97.00	94.00	5.99	8.81	2	0.388	1	1	1	1	1	1.0000	1.000	0.000	1.000	0.698	0.698	0.1373
2.12	101.00	94.00	5.99	8.81	2	0.906	1	1	1	1	1	1.0000	1.000	0.125	0.723	0.365	0.264	0.0519
1.41	80.00	94.00	5.99	8.81	2	-1.812	1	1	1	1	1	1.0000	1.000	0.056	0.813	0.070	0.057	0.0112
4.24	98.00	94.00	5.99	8.81	2	0.518	1	1	1	1	1	1.0000	1.000	0.502	0.479	0.605	0.289	0.0570
0.71	105.00	94.00	5.99	8.81	2	1.424	1	1	1	1	1	1.0000	1.000	0.014	0.906	0.154	0.140	0.0275
0.71	90.00	94.00	5.99	8.81	2	-0.518	1	1	1	1	1	1.0000	1.000	0.014	0.906	0.605	0.548	0.1078
0.71	93.00	94.00	5.99	8.81	2	-0.129	1	1	1	1	1	1.0000	1.000	0.014	0.906	0.897	0.813	0.1599
4.95	112.00	94.00	5.99	8.81	2	2.330	1	1	1	1	1	1.0000	1.000	0.683	0.409	0.020	0.008	0.0016
1.41	94.00	94.00	5.99	8.81	2	0.000	1	1	1	1	1	1.0000	1.000	0.056	0.813	1.000	0.813	0.1600
3.54	80.00	94.00	5.99	8.81	2	-1.812	1	1	1	1	1	1.0000	1.000	0.348	0.555	0.070	0.039	0.0076
7.78	91.00	94.00	5.99	8.81	2	-0.388	1	1	1	1	1	1.0000	1.000	1.686	0.194	0.698	0.135	0.0266
4.95	97.00	94.00	5.99	8.81	2	0.388	1	1	1	1	1	1.0000	1.000	0.683	0.409	0.698	0.285	0.0561
0.71	86.00	94.00	5.99	8.81	2	-1.036	1	1	1	1	1	1.0000	1.000	0.014	0.906	0.300	0.272	0.0536
0.71	92.00	94.00	5.99	8.81	2	-0.259	1	1	1	1	1	1.0000	1.000	0.014	0.906	0.796	0.721	0.1419



$\bar{y} \approx \theta \rightarrow P(\tilde{z}_n)$ high

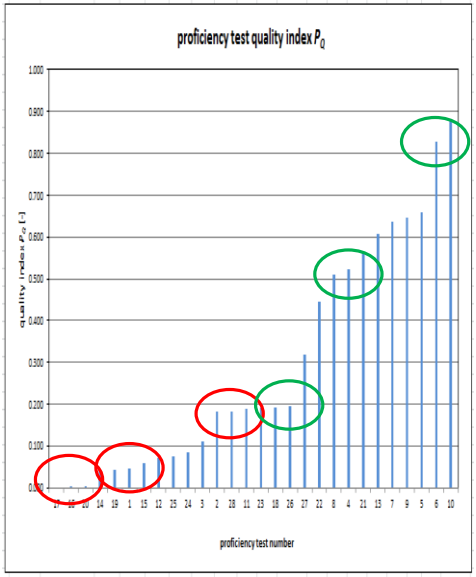
$\bar{y} \lesseqgtr \theta \rightarrow P(\tilde{z}_n)$ low

SCC Reference System

What are the influencing parameters?

Parameters influencing P_Q

s_r	s_R	s_L	σ_r	σ_R	σ_L	p	n	Z_P(rob)	q_1	q_2	q_3	q_4	q_5	q	q(w)	$\hat{\chi}^2_{(r)}$	$\hat{\chi}^2_{(L,r)}$	$P_{(r)}$	$P_{(L,r)}$	P_{Zp}	P_Q	$\tilde{P}_Q$
36.45	39.00	13.87	13.73	21.56	16.62	8	2	0.623	1	1	1	1	1	1	1.00	56.394	16.184	0.0000	0.023	0.826	0.000	0.0000000000
22.48	33.39	24.63	12.65	19.61	14.98	8	2	-0.289	1	1	1	1	1	1	1.00	25.275	19.821	0.0014	0.006	0.919	0.000	0.0000009254
3.00	7.00	6.32	3.33	4.83	3.50	15	2	0.740	1	1	1	1	1	1	1.00	12.174	35.031	0.6656	0.001	0.849	0.001	0.0000993201
16.87	29.47	24.17	15.38	24.78	19.43	8	2	0.643	1	1	1	1	1	1	1.00	9.620	10.254	0.2327	0.175	0.820	0.042	0.0050669598
12.00	73.00	72.01	29.52	59.04	51.13	15	2	0.037	1	1	1	1	1	1	1.00	2.479	24.130	0.9939	0.044	0.532	0.044	0.0052986953
8.60	10.26	5.60	12.62	19.56	14.94	22	15	9.403	1	1	1	1	1	1	1.00	143.031	3.253	1.0000	1.000	0.045	0.045	0.0054366469
13.55	34.52	31.74	16.86	28.09	22.47	8	2	0.906	1	1	1	1	1	1	1.00	5.170	11.897	0.7393	0.104	0.749	0.058	0.0069573820
12.62	39.70	37.64	18.67	33.01	27.22	8	2	1.178	1	1	1	1	1	1	1.00	3.658	11.446	0.8866	0.120	0.677	0.072	0.0087261218
14.00	52.00	50.08	22.35	44.10	38.02	15	2	-0.698	1	1	1	1	1	1	1.00	5.886	21.524	0.9816	0.089	0.857	0.075	0.0090427599
23.00	98.00	95.26	41.88	83.76	72.54	15	2	-0.511	1	1	1	1	1	1	1.00	4.524	21.300	0.9954	0.094	0.895	0.084	0.0101424123
10.28	19.80	16.92	14.67	23.35	18.17	21	15	6.265	1	1	1	1	1	1	1.00	144.369	17.041	1.0000	0.650	0.172	0.112	0.0134827406
12.82	45.33	9.56	18.40	32.35	26.66	22	15	6.280	1	1	1	1	1	1	1.00	149.504	2.929	1.0000	1.000	0.181	0.181	0.0218279472
3.28	9.13	8.52	5.95	8.81	6.46	14	2	-0.388	1	1	1	1	1	1	1.00	4.208	16.992	0.9941	0.200	0.917	0.182	0.0220054163
11.50	31.79	29.54	17.24	28.07	23.41	8	2	0.216	1	1	1	1	1	1	1.00	3.560	9.435	0.8945	0.223	0.939	0.187	0.0226306576
4.00	16.00	15.49	10.53	15.99	12.03	15	2	0.990	1	1	1	1	1	1	1.00	2.164	17.339	1.0000	0.239	0.798	0.190	0.0230092359
9.22	28.33	26.78	16.24	26.61	21.08	8	2	0.541	1	1	1	1	1	1	1.00	2.578	9.231	0.9580	0.237	0.846	0.192	0.0232270538
14.00	39.00	36.40	19.98	36.18	30.16	15	2	0.030	1	1	1	1	1	1	1.00	7.365	17.958	0.9467	0.209	0.994	0.196	0.0237319972
13.55	71.79	70.50	35.66	71.33	61.78	14	2	0.062	1	1	1	1	1	1	1.00	2.021	14.783	0.9999	0.321	0.987	0.317	0.0382869317
11.00	28.00	25.75	17.51	29.84	24.16	15	2	-0.147	1	1	1	1	1	1	1.00	5.920	13.741	0.9811	0.469	0.970	0.446	0.0539361692
5.36	12.06	10.80	9.39	14.13	10.56	27	2	-1.767	1	1	1	1	1	1	1.00	8.794	21.887	0.9996	0.635	0.734	0.510	0.0615939057
14.56	19.48	12.94	20.85	38.55	32.42	21	15	2.918	1	1	1	1	1	1	1.00	143.370	3.362	1.0000	1.000	0.524	0.524	0.0633523237
6.00	19.00	18.03	14.04	22.14	17.12	15	2	0.202	1	1	1	1	1	1	1.00	2.739	12.262	0.9998	0.585	0.958	0.561	0.0677704388
6.58	19.02	17.85	14.96	23.93	18.68	8	2	0.144	1	1	1	1	1	1	1.00	1.548	5.170	0.9919	0.639	0.959	0.608	0.0735170461
15.07	35.89	32.57	23.37	46.75	40.49	27	2	2.132	1	1	1	1	1	1	1.00	11.223	15.965	0.9967	0.937	0.682	0.637	0.0769313962
12.75	33.24	30.70	29.62	59.23	51.30	27	2	2.383	1	1	1	1	1	1	1.00	5.006	8.671	1.0000	0.999	0.646	0.646	0.0780817624
16.46	27.09	21.51	19.10	34.02	28.15	27	2	0.993	1	1	1	1	1	1	1.00	20.089	15.958	0.8276	0.937	0.848	0.656	0.0794738488
7.71	16.44	14.51	15.96	26.01	20.53	27	2	-1.097	1	1	1	1	1	1	1.00	6.304	11.382	1.0000	0.994	0.833	0.828	0.1000597963
16.62	49.53	46.72	35.48	70.95	61.45	27	2	0.649	1	1	1	1	1	1	1.00	5.929	13.697	1.0000	0.977	0.901	0.880	0.1063101088



$S_r < \sigma_r \rightarrow P_r$ high
$S_r > \sigma_r \rightarrow P_r$ low

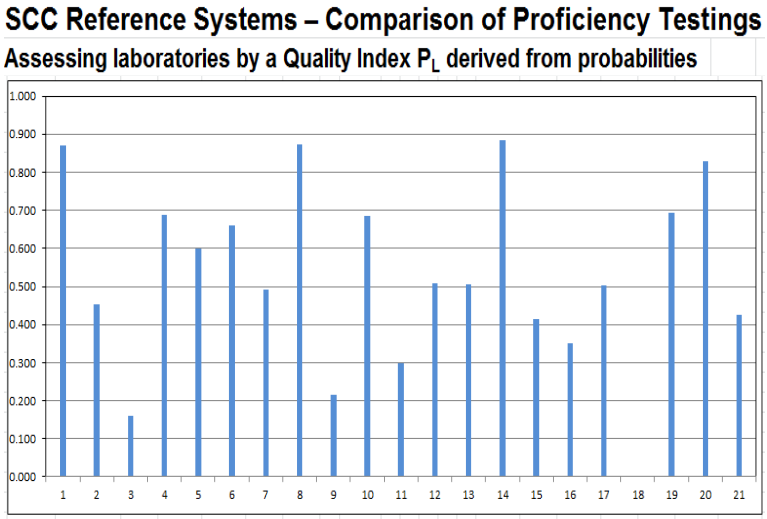
$S_R < \sigma_R \rightarrow P_{L,r}$ high
$S_R > \sigma_R \rightarrow P_{L,r}$ low

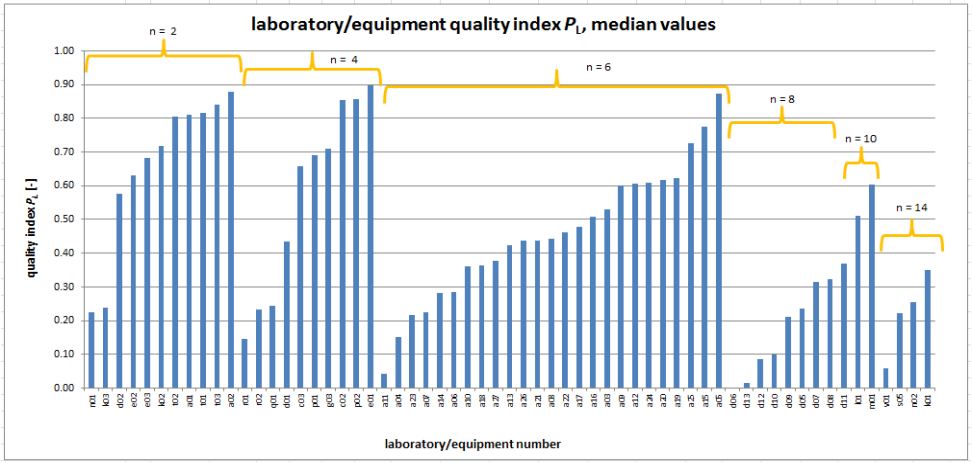
$|Z_P|$ (rob) = «small» → P_{Zp} high
$|Z_P|$ (rob) = «high» → P_{Zp} small

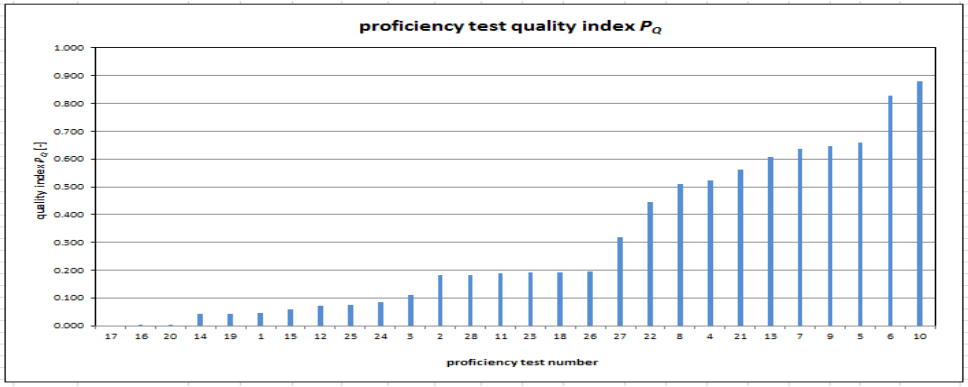
SCC Reference System

Where are we today?

- 28 interlaboratory study levels (5 interlaboratory studies on 2..10 levels) have been included
- with 61 laboratories participating
- resulting in 360 data sets



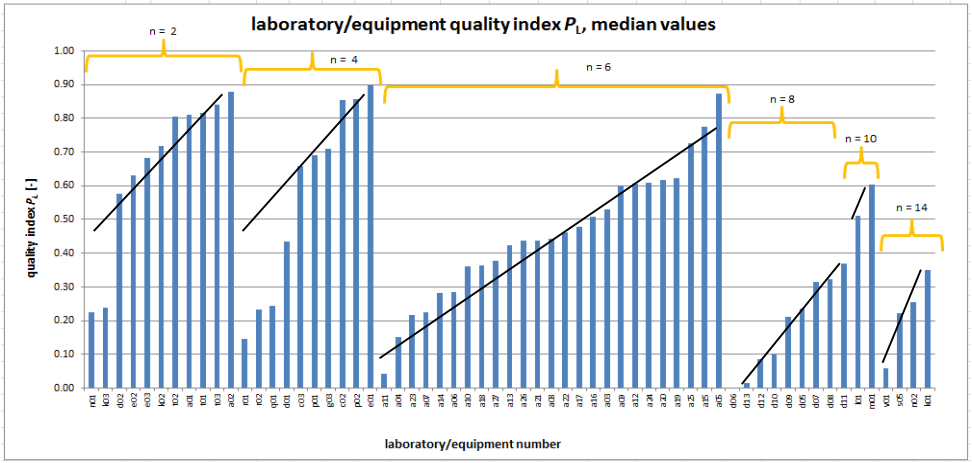




SCC Reference System

Conclusion

- What is needed to implement the system?
  - Looking for a neutral body for the evaluation of the PT data (e.g. international organization, …)
  - Automation of the evaluation
  - Define q-factors e.g. for number of partici-pations, national/inter-national PTs…?



- Statistical model might also be used for other parameters and other PT systems











Thank you for your attention

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