

ACCREDIA

L'ENTE ITALIANO DI ACCREDITAMENTO



A&T AUTOMATION & TESTING

XXXVII Convegno dei Centri di taratura accreditati

23 febbraio 2023



L'ENTE ITALIANO DI ACCREDITAMENTO

Formazione in ambito metrologico: il progetto Mathmet

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Attività MATHMET – MU Training



MATHMET è il Network Europeo di Metrologia che coinvolge la maggioranza degli Istituti di Metrologia Nazionali (NMI)

The screenshot shows the homepage of the MATHMET website. At the top, there is a navigation menu with links for HOME, ABOUT US, THEMES, ACTIVITIES, and STRATEGY. The EURAMET logo is in the top right corner. Below the navigation is a banner with mathematical formulas and the text "Supporting mathematical and statistics". The main heading is "European Metrology Network for Mathematics and Statistics". A paragraph below explains the network's purpose. There are three main sections: "Themes" (Mathmet fields of expertise include modelling, data analysis and AI), "Activities" (Measurement Uncertainty Training Activity), and "Vacancies" (with a "READ MORE" link). Below these are four news items with images and text: "New compendium of examples on measurement uncertainty available" (dated 02-03-22), "EMN Mathmet starts initiative on measurement uncertainty training" (dated 02-02-22), "Workshops on Europe's digital measurement evolution held in September 2021" (dated 08-10-21), and "It's World Metrology Day 2021" (dated 19-05-21).

<https://www.euramet.org/european-metrology-networks/mathmet>

Attività MATHMET – MU Training



Measurement Uncertainty Training Activity

Nuovo materiale per la formazione sulla valutazione dell'incertezza di misura a diversi livelli (istituti di metrologia, università, accreditamento e metrologia legale)



Attività MATHMET – MU Training

- 11 Mathmet partner: PTB (Coordinatore), CEM, GUM, IMBIH, IMS SAS, INRIM, IPQ, LNE, METAS, NPL, SMD
- 5 non-Mathmet members: ACCREDIA Ente Italiano di Accreditamento, Deutsche Akademie für Metrologie (DAM), National Standards Authority of Ireland (NSAI), Politecnico di Torino, University of Konstanz

1 ottobre 2021



30 settembre 2023

MU Training – Task 2.3 Activities Overview

A2.3.3 M1-M6	<p>(Part 1) ACCREDIA, with help from NSAI and SMD, will contact stakeholders from the community of accreditation bodies, such as EA (European co-operation for Accreditation), to inform them about the current activity and to gather information about their current needs in the area of Measurement Uncertainty evaluation and training.</p> <p>(Part 2) In addition, ACCREDIA will undertake a survey of Italian accredited calibration and testing laboratories, and NSAI of accredited testing laboratories, in order to gather information about their requirements.</p>	ACCREDIA NSAI, SMD
A2.3.4 M7-M12	Based on the output of A2.3.3, ACCREDIA, with help from NSAI and SMD, will develop a curriculum for a course on Measurement Uncertainty aimed at the community of accreditation bodies, such as EA.	ACCREDIA NSAI, SMD

MU Training – Task 2.3 Timeline

	Attività	
A2.3.3 Part 1	Contattare e informare componenti EA	Novembre 2021
A2.3.3 Part 2 - Step 1 and 2	Selezionare campione per Focus Group e questionario domande aperte	Dicembre 2021
A2.3.3 Part 2 - Step 3	Progettare questionario	Gennaio 2022
A2.3.3 Part 2 - Step 4	Sottoporre questionario	Febbraio 2022
A2.3.3 Part 2 - Step 5	Raccolta dei risultati questionario	Aprile 2022
A2.3.4	Analisi dei risultati questionario	Settembre 2022
A2.3.4	Definizione Curriculum corso	Gennaio 2023

MU Training – Task 2.3.3 Part 1 EA LETTER

- Informativa al *management group* del *Laboratory Committee* (LC) dell'EA sull'attività di MU Training
- Presentazione dei compiti e degli obiettivi delle attività A.2.3.3 e A.2.3.4 (svolte da Accredia con il supporto di NSAI e SMD)
- Sostegno da parte di EA alla diffusione del questionario tra gli AB



MU Training – Task 2.3.3 Part 2 (step 1 and 2)

SHORT OPEN QUESTIONNAIRE

Sono stati preparati due brevi questionari aperti:

- Il primo questionario è stato inviato a un gruppo selezionato di **laboratori** (sia di prova che di taratura)
- Il secondo questionario è stato inviato a un gruppo scelto di **ispettori tecnici** (sia di prova che di taratura)

DL: 9 laboratori, 8 ispettori

DT: 9 laboratori, 18 ispettori



MU Training – Task 2.3.3 Part 2 (step 1 and 2)

FOCUS GROUP

- 4 Focus Group: laboratori e ispettori per DT e DL
- Discussione partecipata e interattiva, basata sui questionari compilati

Esempio di domanda aperta:

Pensi che i documenti guida utilizzati per la valutazione dell'incertezza e/o per la dichiarazione di conformità siano esaustivi per tutte le situazioni che devi affrontare? Oppure pensi che sia necessaria una formazione e ulteriori esempi per situazioni specifiche?




MU Training – Task 2.3.3 Part 2 (step 3 and 4)

DESIGN OF THE QUESTIONNAIRE

- Progettazione del Questionario a partire da:
 - risultati FOCUS GROUP
 - Curriculum corso sulla valutazione incertezza di misura (F. Pennechi, POLITO)
- Invio del Questionario ai laboratori italiani e agli ispettori tecnici in ambito ISO IEC 17025 (DL e DT)
- Invio della versione in inglese del Questionario alla Segreteria della EA LC

MU Training – Task 2.3.3 Part 2 (step 3 and 4)



MU Training

Informazioni Iniziali

1. Si prega di indicare se la vostra organizzazione è un Organismo di Valutazione * della Conformità (CAB – Laboratorio di Prova o di Taratura), se lei è un Ispettore Tecnico o entrambe le condizioni

CAB
 Ispettore Tecnico
 Entrambi

2. Indicare lo schema di accreditamento / qualifica *

Prova
 Taratura
 Entrambi

1-22. Mathematic elements for the evaluation of uncertainty (linear algebra, partial derivatives, linear regression, etc.)

	1	2	3	4
Your interest	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Your knowledge	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

	Theoretical	Exercises illustrated by the teacher	Exercises carried out by the attendee	Use of dedicated software
Preferred teaching approach (multiple choice possible)	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>

MU Training – Task 2.3.3 Part 2 (step 5)

EA

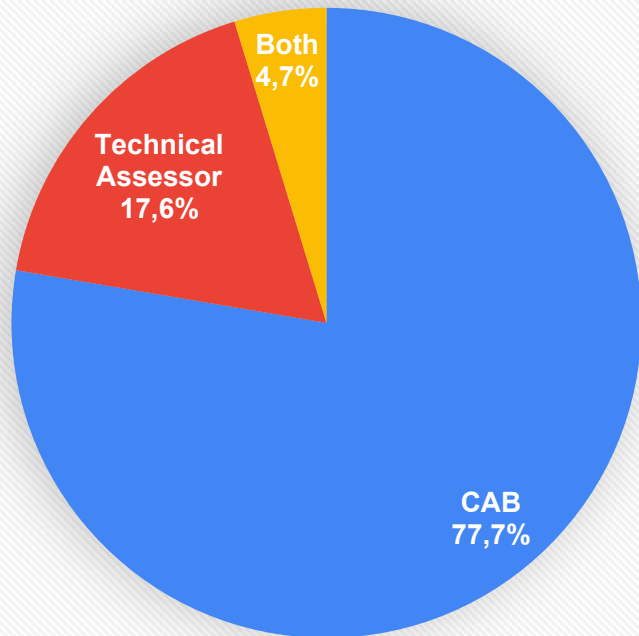
Total Respondents	Expected
586	//

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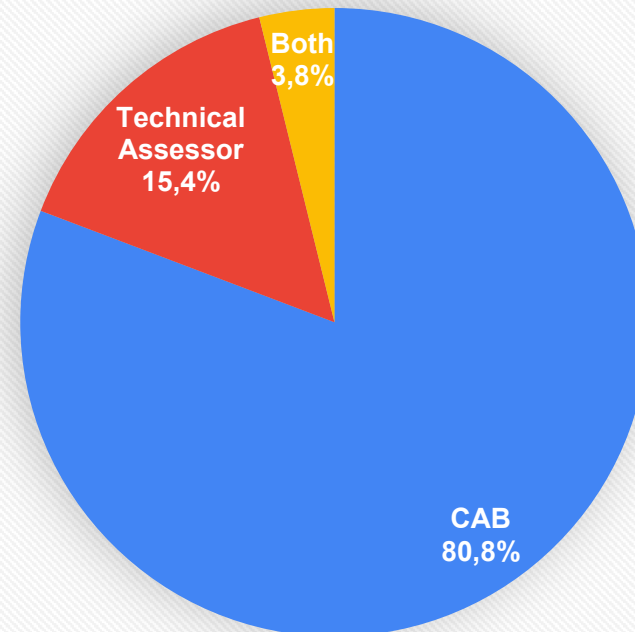
Testing	Respondents	Expected	Calibration	Respondents	Expected
CABs	547 (40,8 %)	1340	CABs	133 (60,2 %)	221
Assessors	155 (64,9 %)	239	Assessors	38 (39,2 %)	97

MU Training – Task 2.3.3 Part 2 (step 5)

Testing

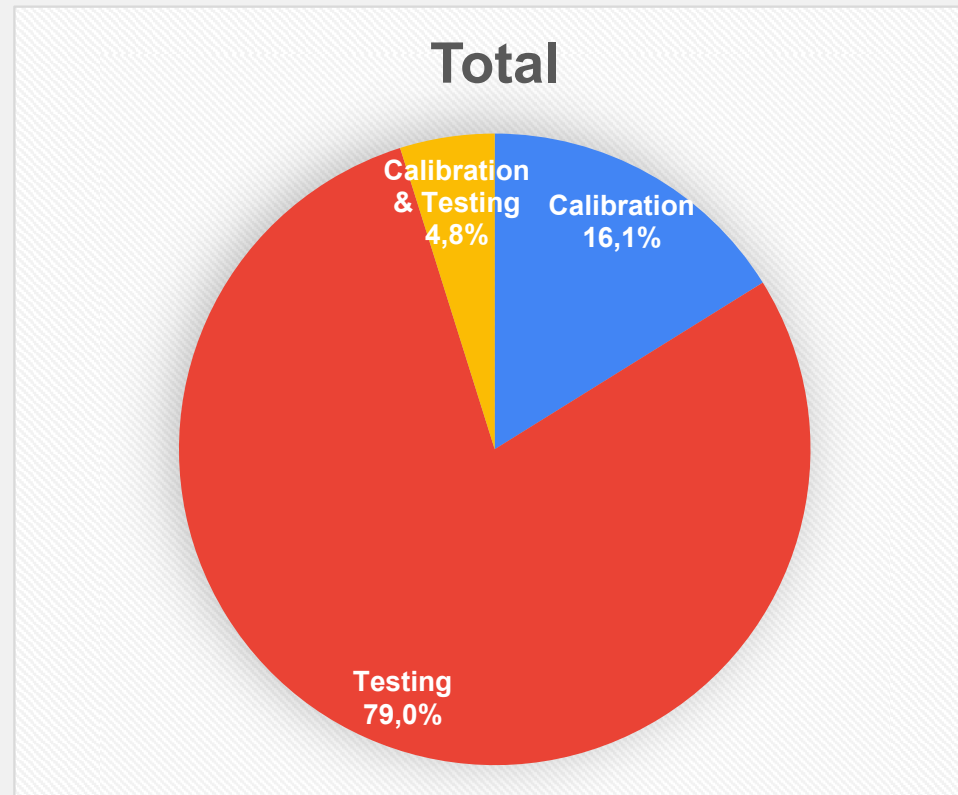


Calibration



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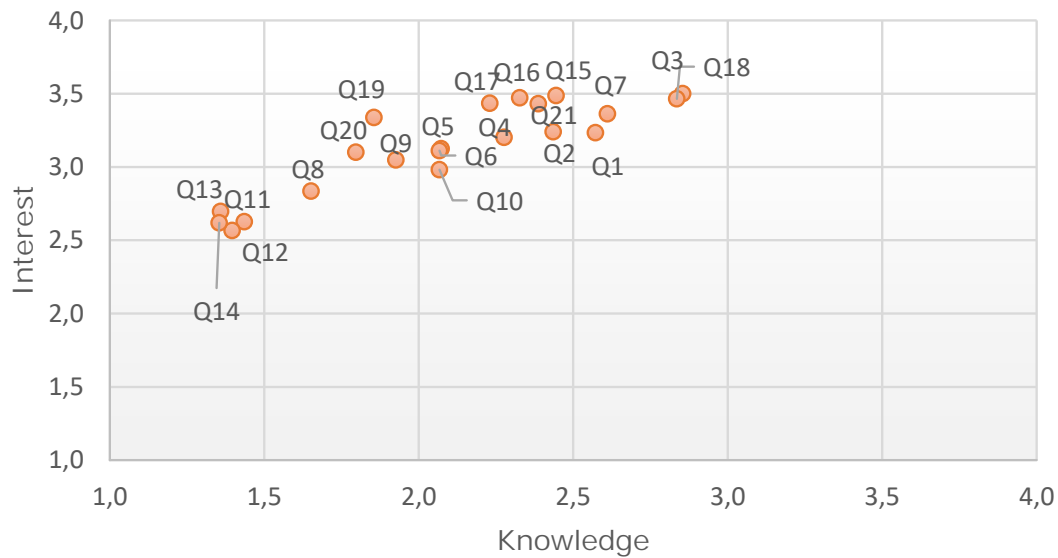
MU Training – Task 2.3.3 Part 2 (step 5)



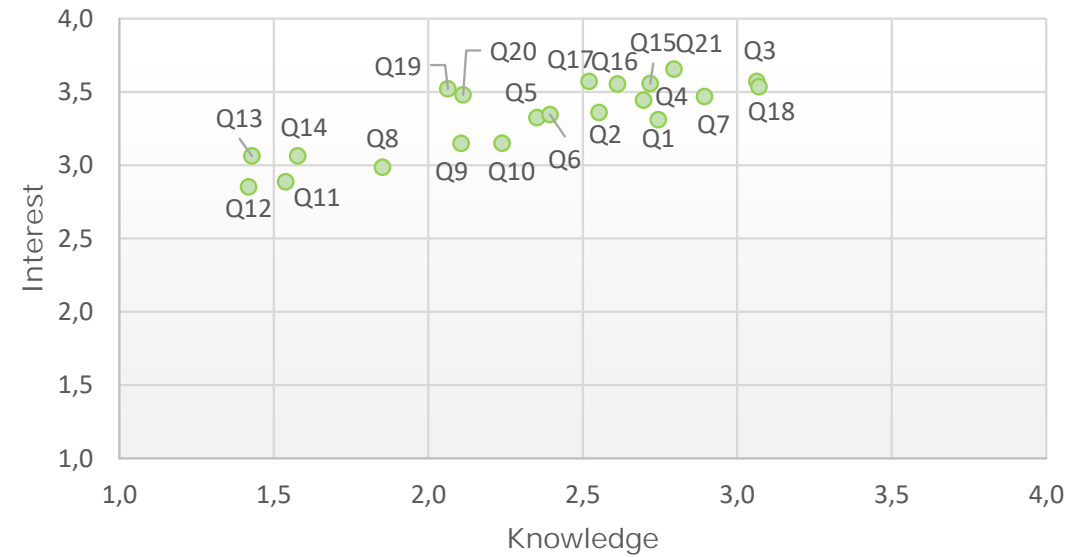
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MU Training – Task 2.3.4 - Analyse questionnaire results

Testing - CAB



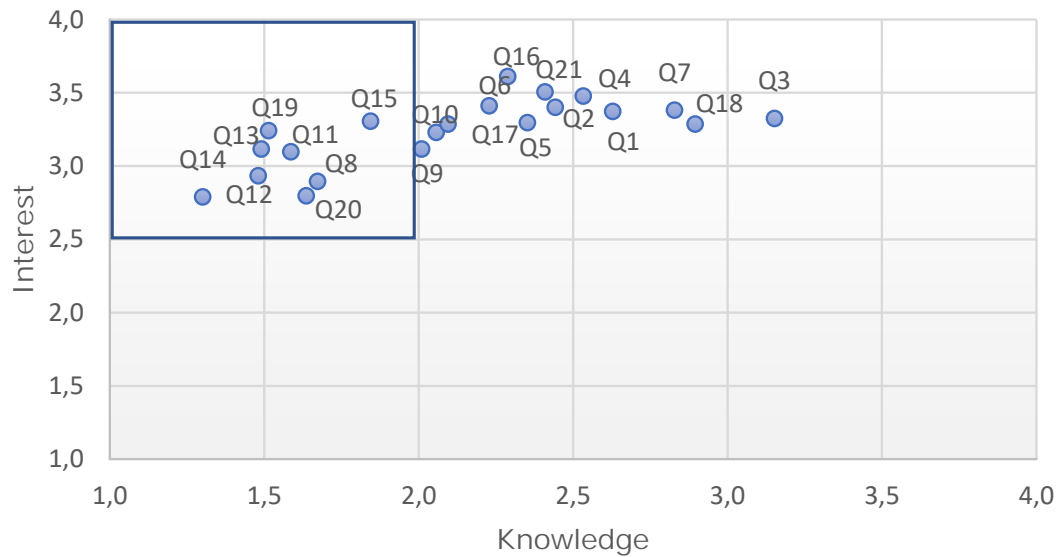
Testing- Technical Assessor



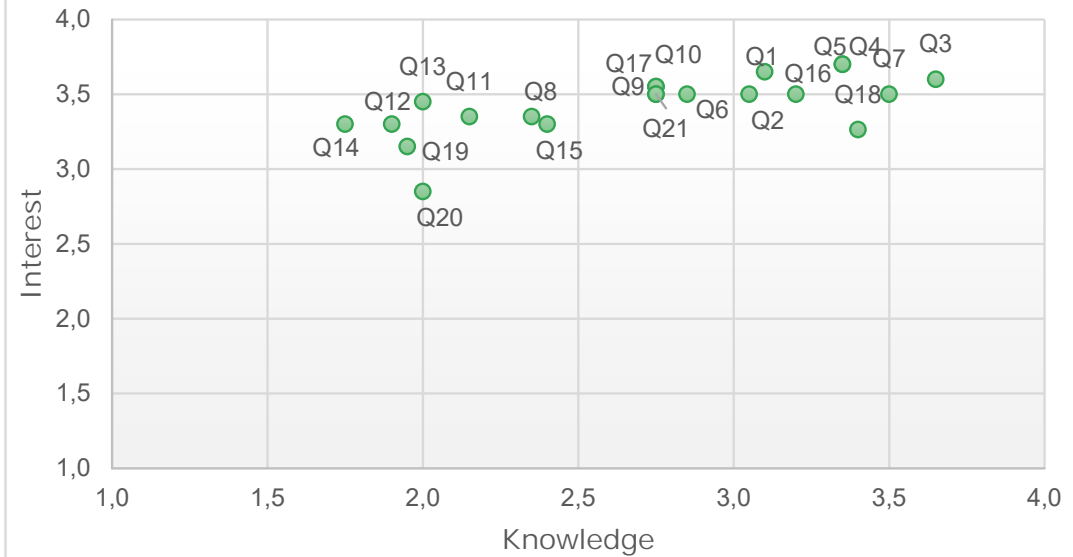
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MU Training – Task 2.3.4 - Analyse questionnaire results

Calibration - CAB



Calibration - Technical Assessor



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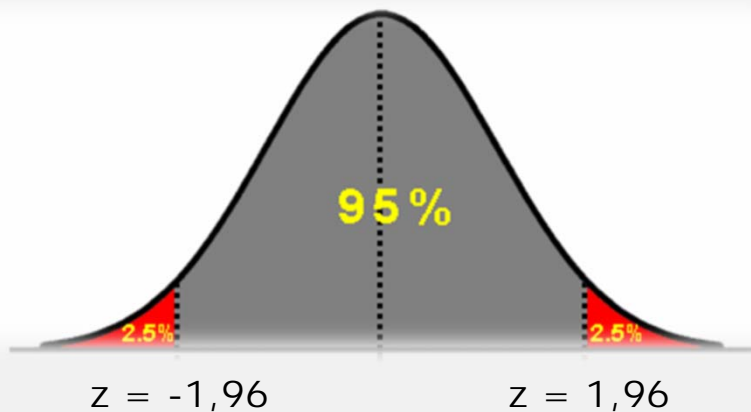
Test Mann - Whitney



H₀: le due popolazioni da cui sono estratti i campioni hanno mediana uguale.

H_A: la mediana della popolazione 1 è diversa della mediana della popolazione 2

$$U = S - \frac{n(n+1)}{2}$$



Se $n, m > 20$

$$|Z_{\text{calc}}| < Z = 1,96$$

$$Z = \frac{U - \frac{mn}{2}}{\sqrt{\frac{mn(n+m+1)}{12}}}$$

MU Training – Task 2.3.4 - Analyse questionnaire results

Q1	Mathematic elements for the evaluation of uncertainty	CAB Test vs CAB Cal	
Q2	Probability and statistics elements	Interest	Knowledge
Q3	Fundamental concepts of metrology		
Q4	GUM approach: evaluation of type A and type B uncertainty components	Isp Test vs Isp Cal	
Q5	GUM approach: combined standard uncertainty evaluation with uncorrelated input quantities		
Q6	GUM approach: combined standard uncertainty evaluation with correlated input quantities	Interest	Knowledge
Q7	GUM approach: determination of expanded uncertainty (U) and coverage factors (k)		
Q8	GUM approach: application of Multivariate Measurement Models (with multiple measurands)	CAB Test vs Isp Test	
Q9	Definition and use of theoretical or empirical measurement models		
Q10	Least Squares Method applied to metrology (with or without correlation between the input quantities)	Interest	Knowledge
Q11	Monte Carlo Method for the propagation of probability distributions applied to measurement models with a single measurand (Univariate model)		
Q12	Monte Carlo Method for the propagation of the probability distributions applied to measurement models with more measurands (Multivariate model)	CAB Cal vs Isp Cal	
Q13	GUM approach vs Monte Carlo method in measurement uncertainty evaluation		
Q14	Alternative methods for the evaluation of the measurement uncertainty based on Bayesian approach	Interest	Knowledge
Q15	Evaluation of measurement uncertainty based on methods validation data		
Q16	Evaluation of measurement uncertainty based on data from participation in ILC/PT and data from practical experience	CAB Cal vs Isp Cal	
Q17	Fitness for purpose of evaluated measurement uncertainty and target uncertainty		
Q18	Reporting measurement result	Interest	Knowledge
Q19	"Uncertainty factor", new approaches for expanded measurement uncertainty evaluation		
Q20	Evaluation of uncertainty from sampling and its contribution to the overall measurement uncertainty	CAB Cal vs Isp Cal	
Q21	Statements of conformity to specifications		

MU Training – Task 2.3.4 - Analyse questionnaire results

	CAB Test		CAB Cal		Isp Test		Isp Cal		CAB Test vs CAB Cal		Isp Test vs Isp Cal		CAB Test vs Isp Test		CAB Cal vs Isp Cal	
	Interest	Knowledge	Interest	Knowledge	Interest	Knowledge	Interest	Knowledge	Interest	Knowledge	Interest	Knowledge	Interest	Knowledge	Interest	Knowledge
Q1	3,23	2,57	3,37	2,65	3,31	2,74	3,60	3,12	1,24	0,85	1,04	1,95	1,14	2,18	1,02	2,36
Q2	3,24	2,44	3,40	2,46	3,36	2,55	3,48	3,00	1,58	0,31	0,23	2,37	1,71	1,51	0,28	2,82
Q3	3,50	2,85	3,31	3,17	3,57	3,06	3,48	3,64	-1,84	3,92	-0,13	3,56	1,01	2,92	1,09	2,91
Q4	3,20	2,28	3,47	2,54	3,44	2,70	3,64	3,20	2,54	2,66	0,71	2,46	2,81	4,72	0,82	3,30
Q5	3,12	2,07	3,29	2,36	3,32	2,35	3,60	3,20	1,53	3,01	1,32	3,88	2,17	3,04	1,54	3,84
Q6	3,11	2,07	3,42	2,24	3,35	2,39	3,52	2,76	2,80	1,76	0,93	1,65	2,44	3,54	0,67	2,40
Q7	3,36	2,61	3,38	2,83	3,47	2,89	3,48	3,36	-0,26	2,06	-0,23	2,31	1,07	3,34	0,41	2,88
Q8	2,83	1,65	2,90	1,66	2,99	1,85	3,28	2,16	0,40	0,40	1,34	1,40	1,34	2,55	1,76	2,22
Q9	3,05	1,93	3,11	1,99	3,15	2,11	3,44	2,52	0,53	0,49	1,30	2,09	0,94	2,11	1,47	2,46
Q10	2,98	2,07	3,24	2,07	3,15	2,24	3,52	2,68	2,32	0,04	1,15	2,24	1,58	1,78	1,19	3,07
Q11	2,63	1,44	3,09	1,60	2,89	1,54	3,28	2,08	4,04	2,07	1,76	2,81	2,47	1,70	0,89	2,52
Q12	2,57	1,40	2,94	1,49	2,85	1,42	3,24	1,84	3,13	1,38	1,79	2,48	2,66	0,92	1,36	2,12
Q13	2,70	1,36	3,11	1,50	3,06	1,43	3,36	1,92	3,53	1,81	1,50	2,69	3,50	1,27	1,40	2,31
Q14	2,62	1,35	2,79	1,30	3,06	1,58	3,20	1,64	1,36	-0,79	0,68	0,33	4,07	3,28	1,78	1,98
Q15	3,49	2,45	3,30	1,83	3,56	2,72	3,28	2,25	-1,59	-6,44	-1,70	-2,35	0,79	3,30	-0,45	1,88
Q16	3,47	2,33	3,61	2,28	3,55	2,61	3,52	3,00	1,03	-0,35	-0,44	1,89	0,99	3,30	-0,50	3,60
Q17	3,43	2,23	3,29	2,12	3,57	2,52	3,48	2,72	-1,56	-1,15	-0,82	0,92	1,71	3,21	0,74	2,75
Q18	3,47	2,84	3,28	2,90	3,54	3,07	3,25	3,32	-1,39	0,77	-1,34	1,55	0,69	3,20	-0,31	2,54
Q19	3,34	1,86	3,25	1,52	3,52	2,06	3,20	1,88	-1,02	-3,95	-1,52	-0,80	1,87	2,03	-0,22	2,00
Q20	3,10	1,80	2,84	1,65	3,48	2,11	3,04	2,00	-2,57	-1,60	-1,72	-0,57	3,22	3,43	0,92	1,59
Q21	3,43	2,39	3,49	2,45	3,65	2,80	3,44	2,84	0,54	0,58	-1,33	0,31	2,35	4,61	-0,50	2,01

MU Training – Task 2.3.4 - Analyse questionnaire results

	CAB Test		CAB Cal		Isp Test		Isp Cal		CAB Test vs CAB Cal		Isp Test vs Isp Cal		CAB Test vs Isp Test		CAB Cal vs Isp Cal	
	Interest	Knowledge	Interest	Knowledge	Interest	Knowledge	Interest	Knowledge	Interest	Knowledge	Interest	Knowledge	Interest	Knowledge	Interest	Knowledge
Q1	3,23	2,57	3,37	2,65	3,31	2,74	3,60	3,12	1,24	0,85	1,04	1,95	1,14	2,18	1,02	2,36
Q2	3,24	2,44	3,40	2,46	3,36	2,55	3,48	3,00	1,58	0,31	0,23	2,37	1,71	1,51	0,28	2,82
Q3	3,50	2,85	3,31	3,17	3,57	3,06	3,48	3,64	-1,84	3,92	-0,13	3,56	1,01	2,92	1,09	2,91
Q4	3,20	2,28	3,47	2,54	3,44	2,70	3,64	3,20	2,54	2,66	0,71	2,46	2,81	4,72	0,82	3,30
Q5	3,12	2,07	3,29	2,36	3,32	2,35	3,60	3,20	1,53	3,01	1,32	3,88	2,17	3,04	1,54	3,84
Q6	3,11	2,07	3,42	2,24	3,35	2,39	3,52	2,76	2,80	1,76	0,93	1,65	2,44	3,54	0,67	2,40
Q7	3,36	2,61	3,38	2,83	3,47	2,89	3,48	3,36	-0,26	2,06	-0,23	2,31	1,07	3,34	0,41	2,88
Q8	2,83	1,65	2,90	1,66	2,99	1,85	3,28	2,16	0,40	0,40	1,34	1,40	1,34	2,55	1,76	2,22
Q9	3,05	1,93	3,11	1,99	3,15	2,11	3,44	2,52	0,53	0,49	1,30	2,09	0,94	2,11	1,47	2,46
Q10	2,98	2,07	3,24	2,07	3,15	2,24	3,52	2,68	2,32	0,04	1,15	2,24	1,58	1,78	1,19	3,07
Q11	2,63	1,44	3,09	1,60	2,89	1,54	3,28	2,08	4,04	2,07	1,76	2,81	2,47	1,70	0,89	2,52
Q12	2,57	1,40	2,94	1,49	2,85	1,42	3,24	1,84	3,13	1,38	1,79	2,48	2,66	0,92	1,36	2,12
Q13	2,70	1,36	3,11	1,50	3,06	1,43	3,36	1,92	3,53	1,81	1,50	2,69	3,50	1,27	1,40	2,31
Q14	2,62	1,35	2,79	1,30	3,06	1,58	3,20	1,64	1,36	-0,79	0,68	0,33	4,07	3,28	1,78	1,98
Q15	3,49	2,45	3,30	1,83	3,56	2,72	3,28	2,25	-1,59	-6,44	-1,70	-2,35	0,79	3,30	-0,45	1,88
Q16	3,47	2,33	3,61	2,28	3,55	2,61	3,52	3,00	1,03	-0,35	-0,44	1,89	0,99	3,30	-0,50	3,60
Q17	3,43	2,23	3,29	2,12	3,57	2,52	3,48	2,72	-1,56	-1,15	-0,82	0,92	1,71	3,21	0,74	2,75
Q18	3,47	2,84	3,28	2,90	3,54	3,07	3,25	3,32	-1,39	0,77	-1,34	1,55	0,69	3,20	-0,31	2,54
Q19	3,34	1,86	3,25	1,52	3,52	2,06	3,20	1,88	-1,02	-3,95	-1,52	-0,80	1,87	2,03	-0,22	2,00
Q20	3,10	1,80	2,84	1,65	3,48	2,11	3,04	2,00	-2,57	-1,60	-1,72	-0,57	3,22	3,43	0,92	1,59
Q21	3,43	2,39	3,49	2,45	3,65	2,80	3,44	2,84	0,54	0,58	-1,33	0,31	2,35	4,61	-0,50	2,01

MU Training – Task 2.3.4 – Definizione Curriculum

- Selezione degli argomenti di elevato interesse
- Analisi del livello di conoscenza ed eventuali differenze significative tra le classi di rispondenti
- Definizione del Curriculum

MU Training – Task 2.3.4 – Definizione Curriculum

<p>Q3 Fundamental concepts of metrology</p>	<p>Q7 GUM approach: determination of expanded uncertainty (U) and coverage factors (k)</p>	<p>Q16 Evaluation of measurement uncertainty based on data from participation in ILC/PT and data from practical experience</p>	<p>Q 21 Statements of conformity to specifications</p>
<p>BASE CAB Test</p>	<p>BASE CAB Test</p>	<p>BASE CAB Test CAB Cal</p>	<p>BASE CAB Test CAB Cal</p>
<p>MEDIO CAB Cal Isp Test</p>	<p>MEDIO CAB Cal Isp Test</p>	<p>AVANZATO Isp Cal Isp Test</p>	<p>AVANZATO Isp Cal Isp Test</p>
<p>AVANZATO Isp Cal</p>	<p>AVANZATO Isp Cal</p>		

MU Training – Traduzione Video

Explaining the coverage factor k for expanded uncertainties

Measurement uncertainty teaser (software)

Explaining the importance of data quality



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