MUkit Measurement Uncertainty Kit

Developing a practical software application for environmental laboratories to evaluate measurement uncertainty

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What am I going to talk about?

- MUkit is a measurement uncertainty application for environmental laboratories developed in the Finnish Environment Institute (SYKE).
- Project group (2011-2012):
  - Teemu Näykki (specification and laboratory insight)
  - Atte Virtanen (as master thesis work)
- This presentation is about the background, requirements and architecture of MUkit.
Contents

- Current state (2011) of measurement uncertainty evaluation in environmental laboratories and therefore software requirements
- Designing the software: The program architecture
- Designing the software: The architecture of the measurement uncertainty library
- Designing the software: UI Navigation and Demo
- Current situation of MUkit
Current state (2011) of measurement uncertainty evaluation in environmental laboratories and therefore software requirements
Current state of measurement uncertainty evaluation in environmental laboratories

- 10 – 25% of laboratories are giving unrealistic measurement uncertainties (SYKE’s proficiency tests 2000-2009) [1]
- As a part of the development a survey was made (answers from 65 laboratory departments) in 2011

- Do they evaluate measurement uncertainties?

- What guidebooks are used?
Current state of measurement uncertainty evaluation in environmental laboratories

- What methods are used?
- Is the measurement uncertainty given to the customers?
- Control and routine sample results are mostly held in Excel (68%) and LIMS-systems (52%).
Software requirements for MUkit

- To be based on the most popular guidebook Nordtest TR 537 [2], and its most popular methods
  - Nordtest TR 537 is based on the idea, that measurement uncertainty is evaluated using quality control data
  - Within laboratory reproducibility from control samples and possibly routine sample replicates
  - Laboratory and method bias from interlaboratory comparisons, certified reference materials or recovery tests
- Results should be possible to be imported from Excel and LIMS
- Interlaboratory comparisons should be possible to bring in an automated way from proficiency test providers
- The program would make it possible to document and maintain measurement uncertainty evaluations
  - In addition to numeric values, quality information should be obtained
Designing the software:
The program architecture
LIMS

Import from chart
LIMS connection library
Proficiency test result library

Measuremnt uncertainty library
User interface program
File control

User

Measurement uncertainty evaluation

muk-file

Excel

Control and routine sample results

Customer specific proficiency test results

XML-file with proficiency test results
1. Measurement uncertainty library (the core of the software)

2. Windows user interface application

3. Measurement uncertainty report generator (according to measurement uncertainty library)

4. LIMS connection library from ODBC and Web Services

5. Library for proficiency test result import

6. Proficiency provider’s web service

7. A laboratory’s LIMS Web Service
Designing the software: About technology

- MUkit was decided to be a desktop application because
  - Does not need a large scalable database
  - Should have access to the local data sources (ODBC) for LIMS-systems
  - Easy installation for laboratories (no server needed)

- The Microsoft .NET Framework was chosen as the software environment (programming language C#)
  - All laboratories have Microsoft Windows (according to the survey made)
  - Development is more effective in a managed runtime environment (MRTE)
  - No need for machine code efficiency
  - In SYKE the .NET Framework and C# is used for information system development
Designing the software: The architecture of the measurement uncertainty library
Within laboratory reproducibility

Stable sample like control samples

Synthetic control samples

Routine replicate samples

Reproducibility

Method and laboratory bias

Recovery tests

Interlaboratory comparisons

Suitable reference material

Evaluation not possible with MUkit

Bias

Combined measurement uncertainty

\[ u_c = \sqrt{s_{Rw}^2 + u_{bias}^2} \]
1. Analysis method for which evaluations are made.

2. Measurement uncertainty evaluation for a certain concentration range.

3. Evaluations consist of a "Bias Contributor", "Control Samples" and possibly "Replicate Samples".

4. "Bias contributor" consists either from interlaboratory comparisons, CRMs or recovery tests.

5. Both "replicate samples" and "control samples" can consist of either "test series list results" (just result values) or a "test series list". The "test series list" in turn consist of "test series" (replicate sample series=a result) which in turn consists of a replicate measurement.
Designing the software:

UI Navigation and Demo
1. The main window: analysis method information

2. To the "analysis method", new evaluations can be added, through a new window

3. The information can be input either as ready values or through MUKit’s chart

4. The sheets can be populated from a LIMS-System

5. Proficiency tests can be brought from MUKit’s proficiency test data bank (new feature being developed)

6. Generation of general and Nordtest TR 537 reports
Designing the software: Demo

- A brief demonstration of the user interface
Current situation of MUkit

- A free, open source (although the code is not commented) measurement uncertainty evaluation software application has been developed for environmental routine laboratories.
- Further development which has been made (2013):
  - The application has been translated into Russian as a part of the Water quality monitoring in the Kyrgyz Republic project.
  - Absolute evaluation of uncertainty is a new feature being slowly developed.
  - Proficiency test importation for customers from SYKE’s new Proftest-application through xml-files is being developed.
  - A test version with these new features is downloadable at the website [3]
Thank you!

Questions?
Sources

