

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

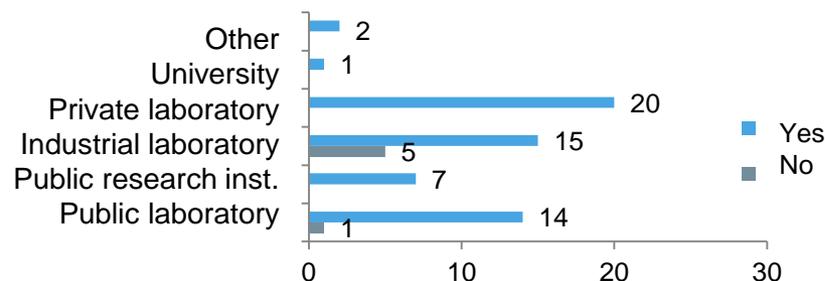
- Current state (2011) of measurement uncertainty evaluation in environmental laboratories and therefore software requirements
- Designing the software: The program architecture
- Designing the software: The architecture of the measurement uncertainty library
- Designing the software: UI Navigation and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

Current state (2011) of measurement uncertainty evaluation in environmental laboratories and therefore software requirements

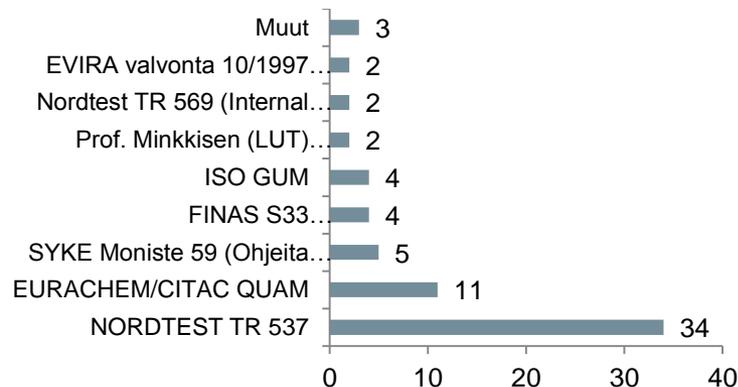
Current state of measurement uncertainty evaluation in environmental laboratories

- 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?

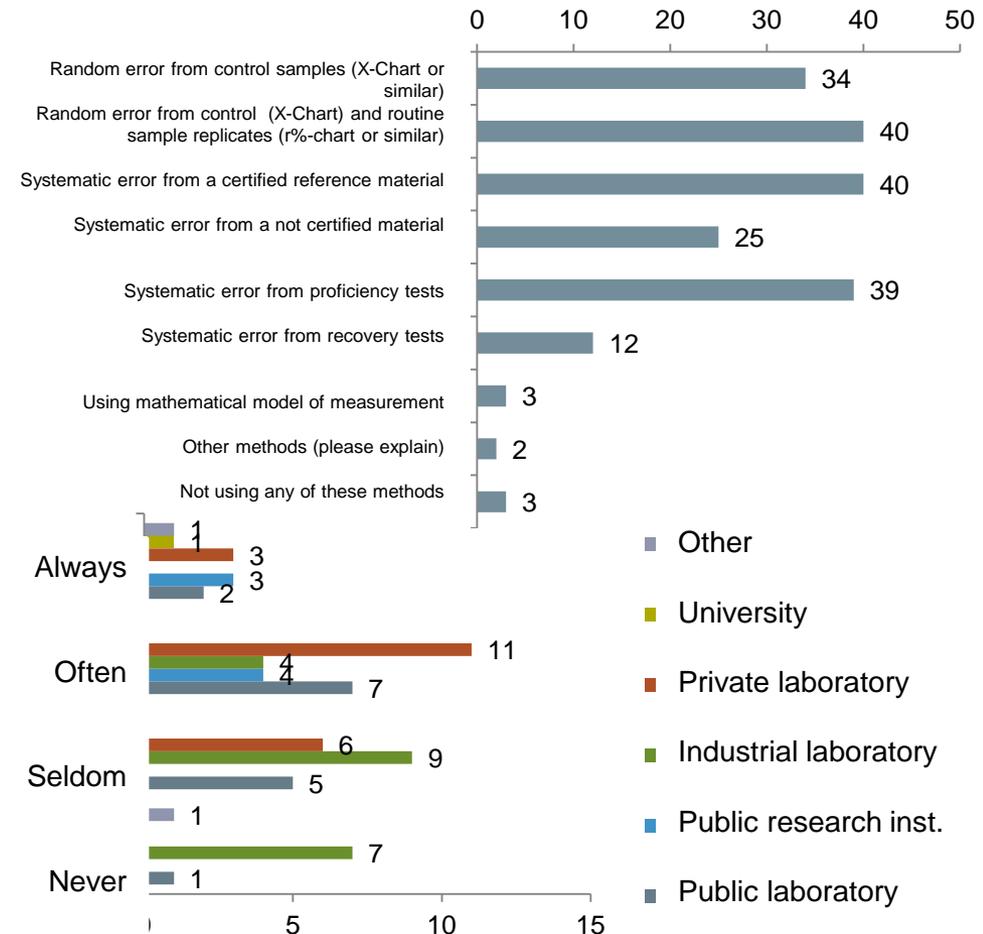


- What guidebooks are used?



Current state of measurement uncertainty evaluation in environmental laboratories

- What methods are used?



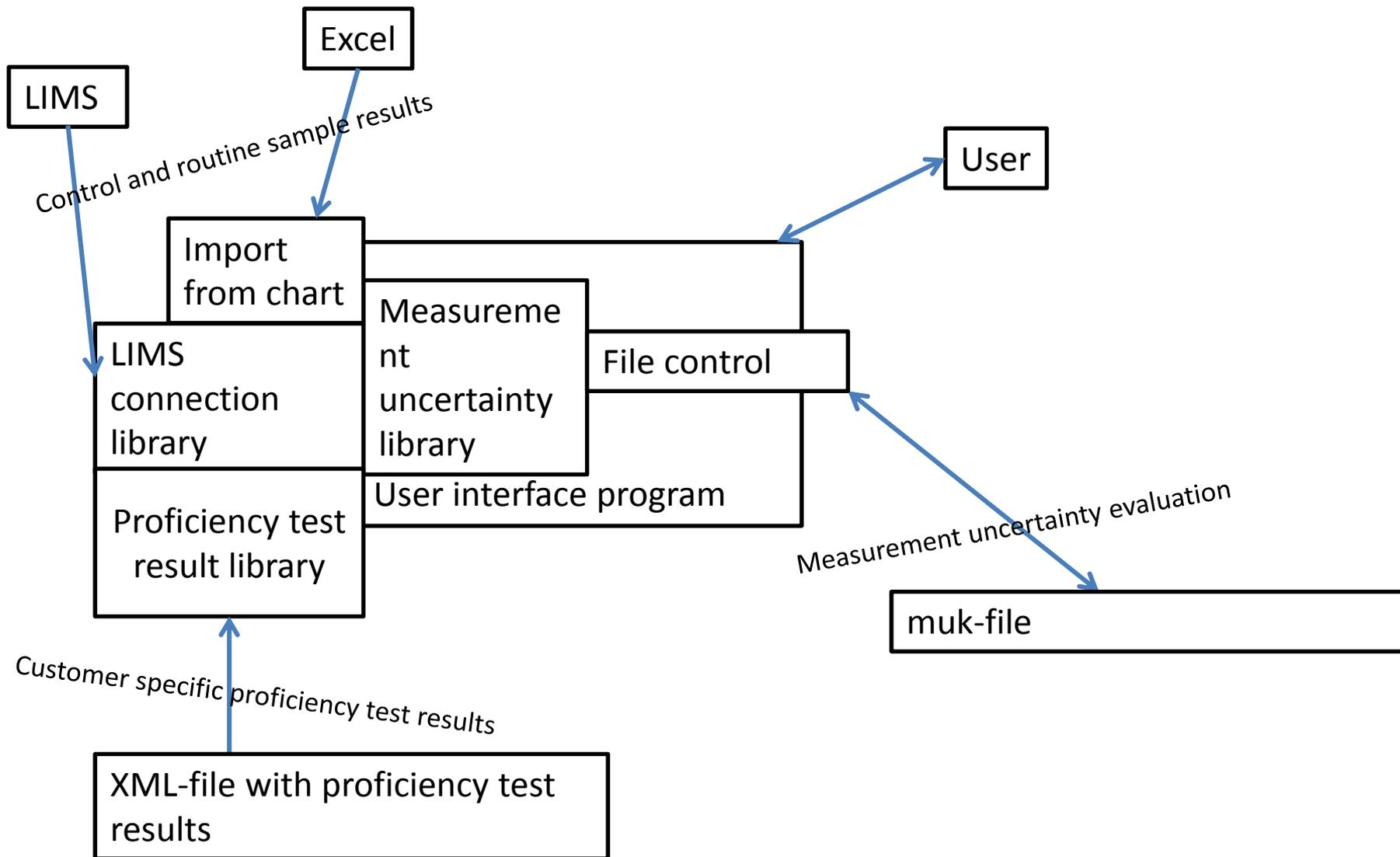
- Is the measurement uncertainty given to the customers?

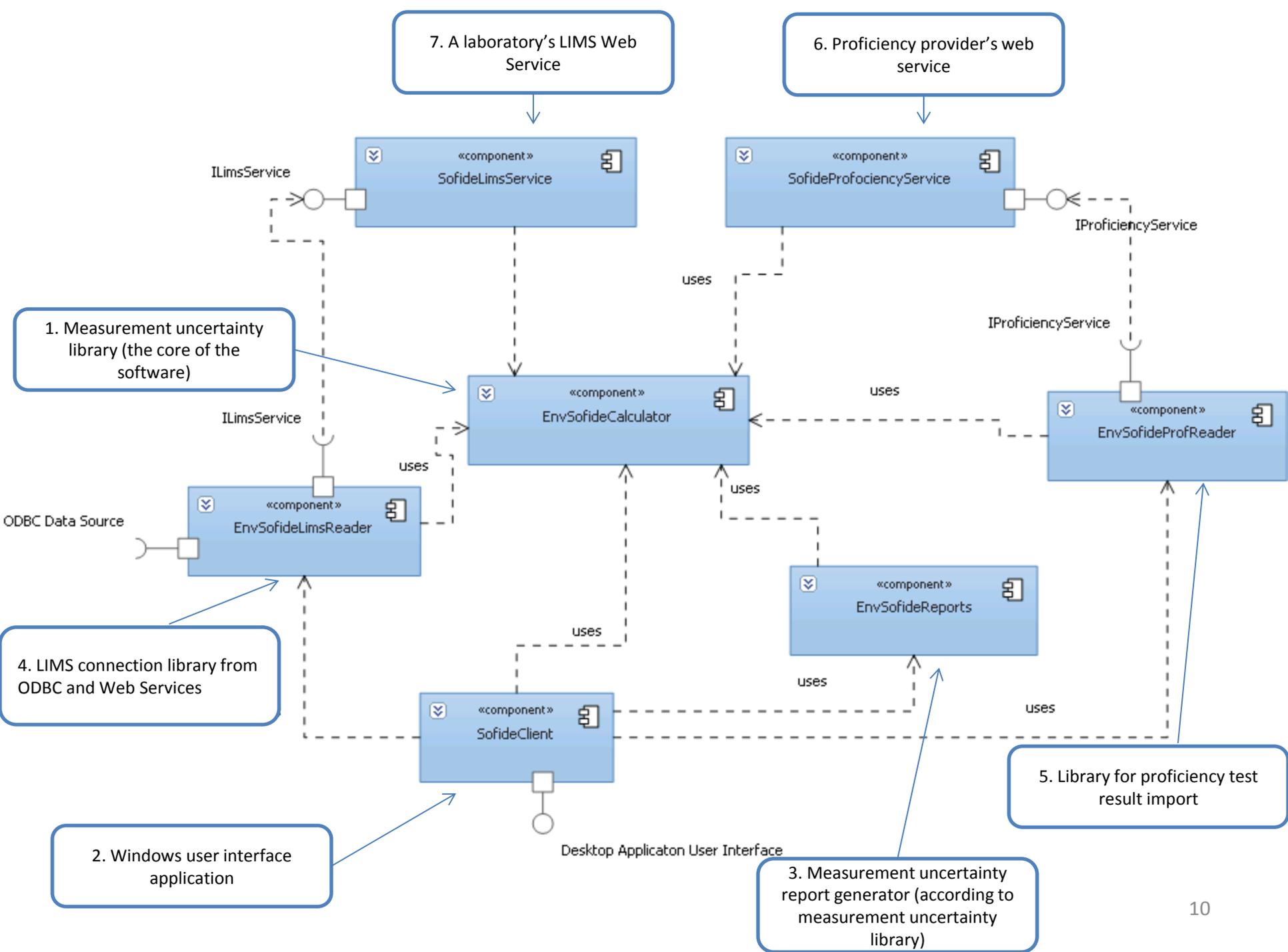
- Control and routine sample results are mostly held in Excel (68 %) and LIMS-systems (52 %).

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





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**

Start of evaluation

Within laboratory reproducibility

Method and laboratory bias

Stable sample like control samples

Synthetic control samples

no

no

yes

yes

Routine replicate samples

no

yes

Reproducibility

$$S_{Rw}$$

Recovery tests

no

yes

no

yes

Interlaboratory comparisons

no

yes

Suitable reference material

yes

Evaluation not possible with MUKIT

Bias

$$u_{bias}$$

Combined measurement uncertainty

$$u_c = \sqrt{S_{Rw}^2 + u_{bias}^2}$$

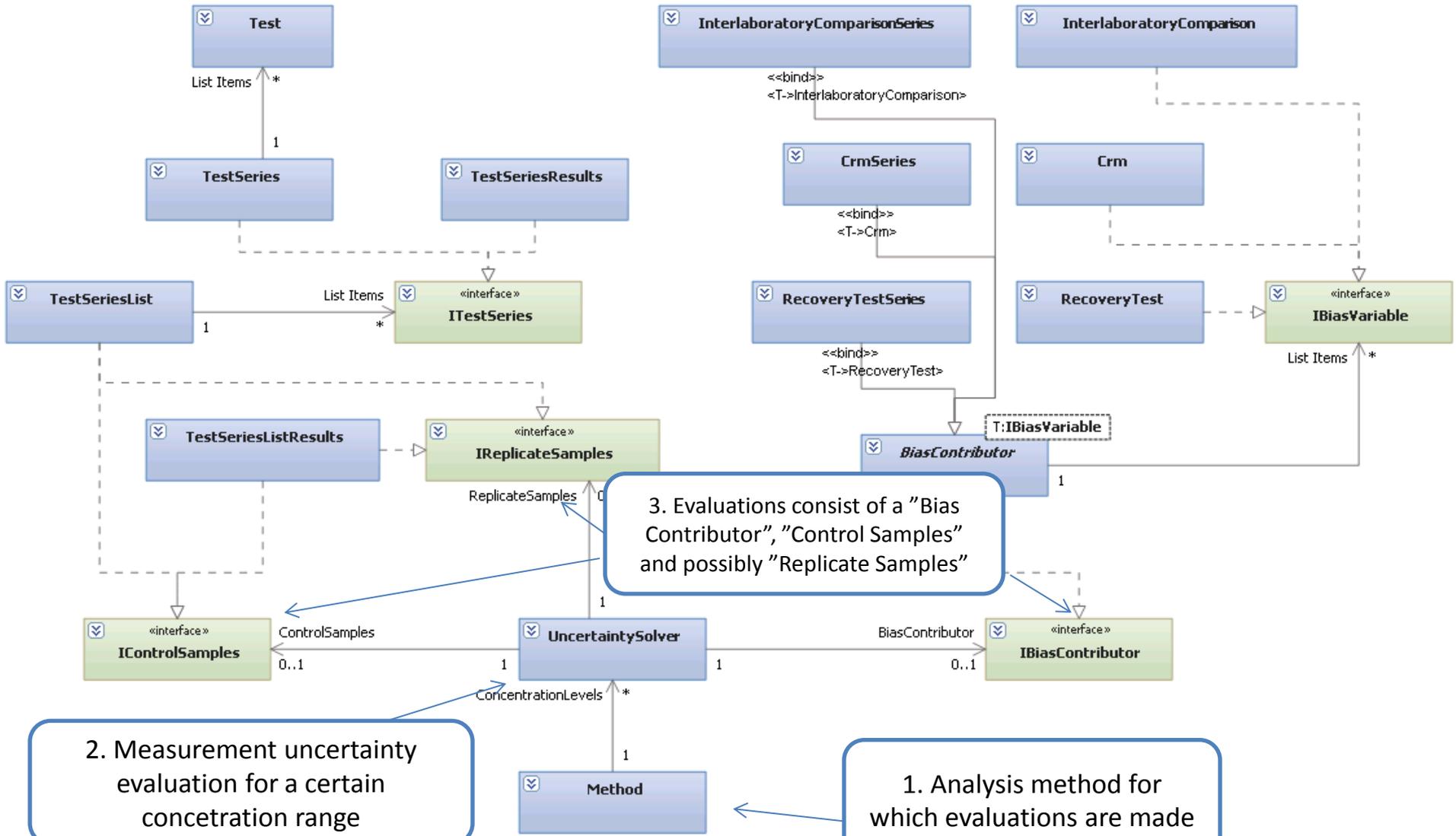
5. Both "replicate samples" and "control samples" can consist of either "test series list results" (just result values) or a "test series list". The "test series list" in turn consist of "test series" (replicate sample series=a result) which in turn consists of a replicate measurement.

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

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

2. Measurement uncertainty evaluation for a certain concentration range

1. Analysis method for which evaluations are made



Designing the software:

UI Navigation and Demo



6. Generation of general and Nordtest TR 537 reports

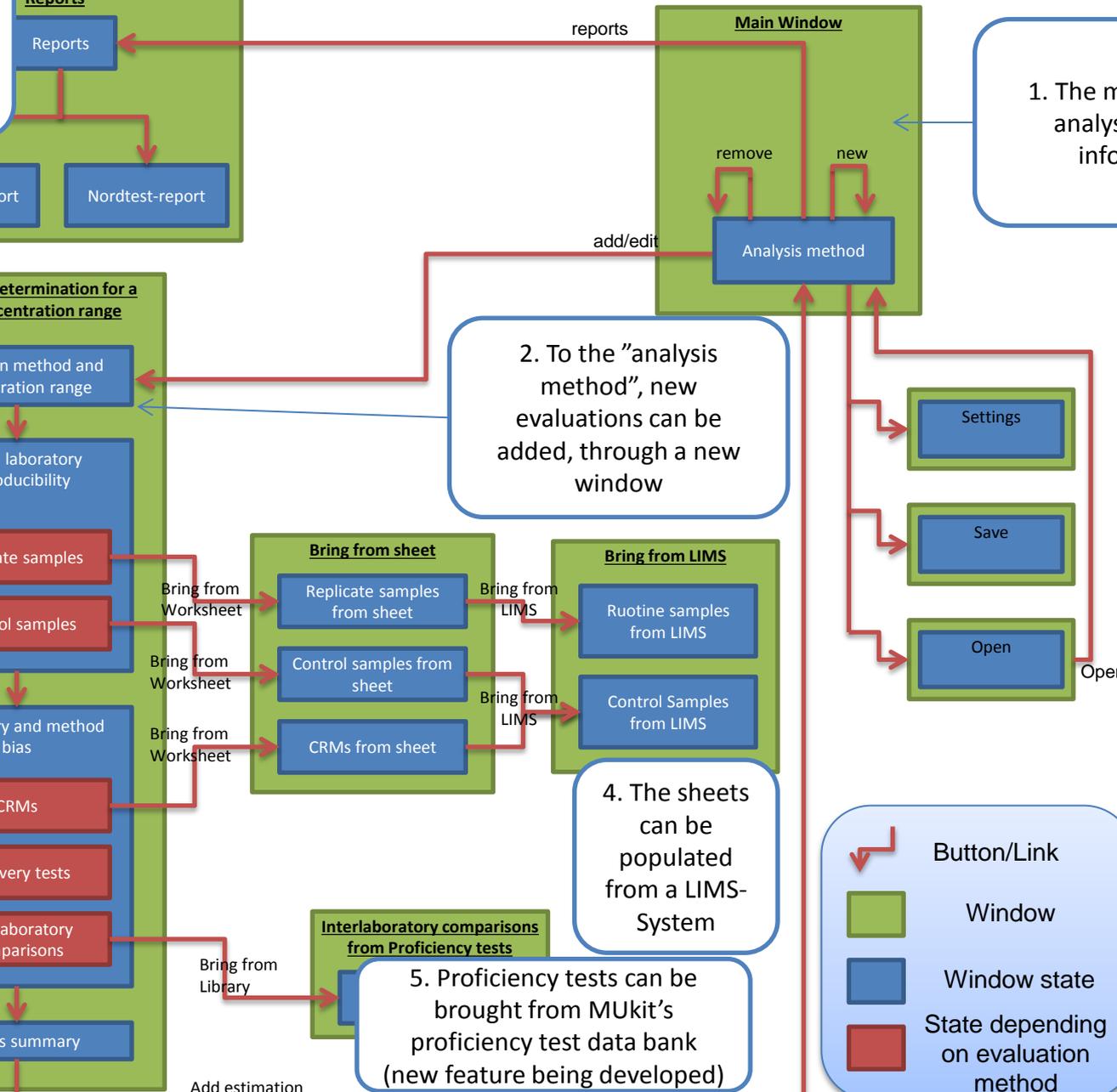
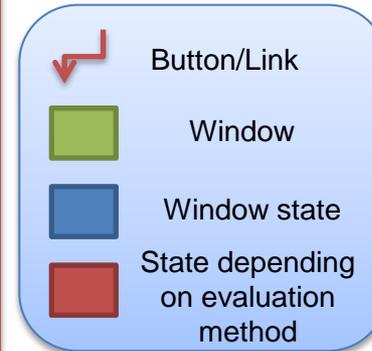
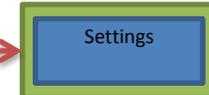
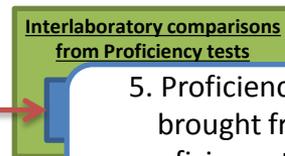
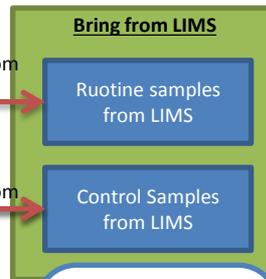
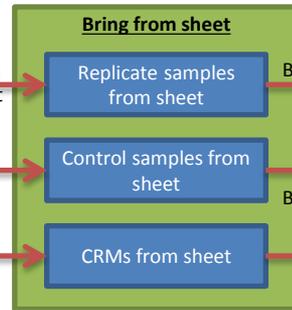
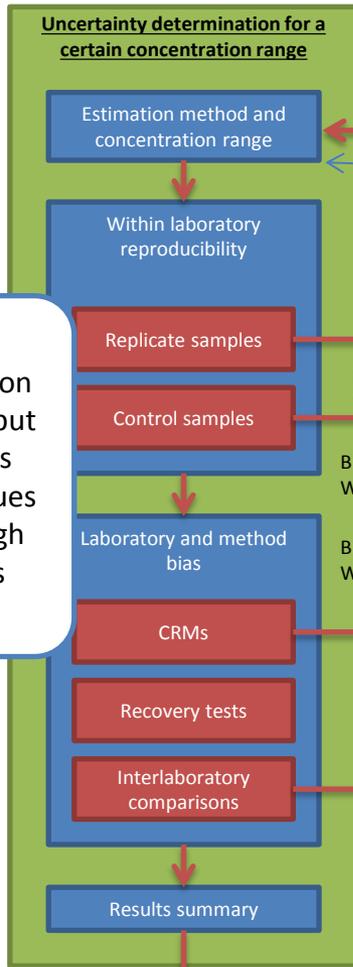
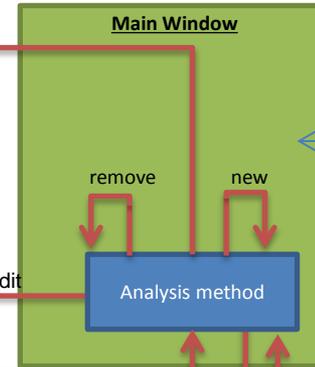
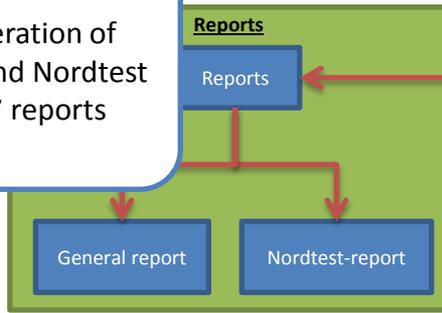
1. The main window: analysis method information

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)



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

- [1] Mäkinen, I., Use of uncertainty estimates as reported by participants in proficiency testing for the evaluation of their results: pros and cons, *Accreditation and Quality Assurance* **14** (2009) 35-41.
- [2] Magnusson, B., Näykki, T., Hovind, H. ja Krysell, M., *TR 537 - Handbook for the calculation of measurement uncertainty in environmental laboratories*, 2. painos, Nordtest, Espoo, 2004.
- [3] SYKE ENVICAL - MUKIT Web Page. http://www.syke.fi/en-US/Services/Calibration_services_and_contract_laboratory/MUKIT_Measurement_Uncertainty_Kit.