

Assessment of Water Quality: QA/QC in Analytical Works

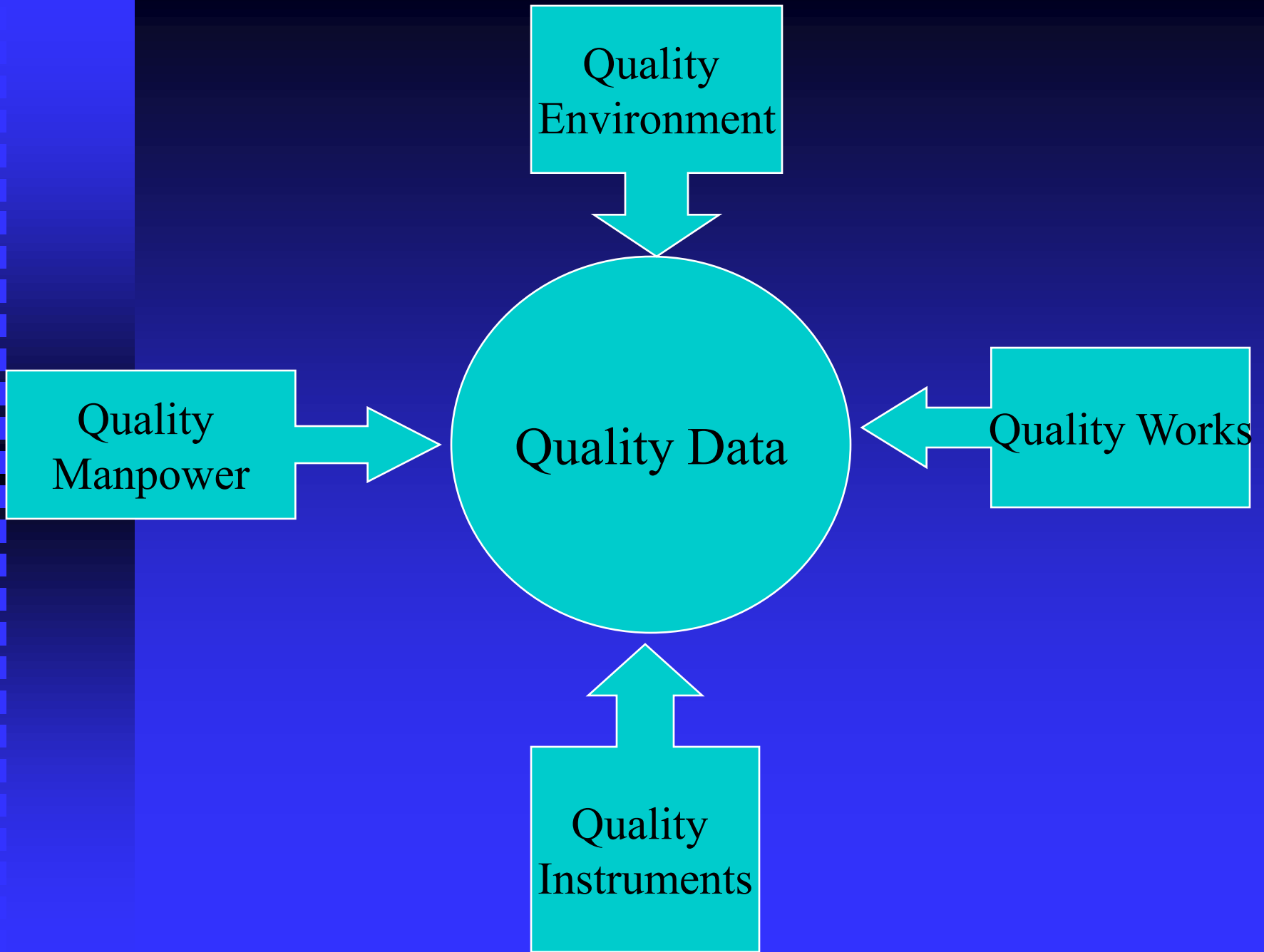
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Quality

What do we mean by quality?

Quality is all about providing results which:

- Meet the specific needs of customer
- Attract the confidence of the customer and all others who make use of the results
- Represent value for money



Quality Assurance

Definition:

- ❑ A planned system of activities designed to ensure that the quality control programme is effective

or

- ❑ All those planned and systematic actions necessary to provide adequate confidence that a product or service will satisfy given requirements for quality

Management

Comprehensive management documents which should describe, in detail, the management structure of the laboratory.

Specify the role of quality assurance within the laboratory and clearly define who is responsible for each area and activity.

Training

All staff are adequately trained for the task they have to perform .

Verification of competency to conduct the duties

Standard Operating Procedures

Documents that in detail describe every procedure conducted by the laboratory.

Includes sampling, transportation, analysis, use of equipment, quality control, calibration, production of reports, etc.

Laboratory facilities

space, staff, equipment, environment and supplies, are sufficient and well controlled

Equipment maintenance and calibration

maintained on a regular basis, consistent with the documented Criteria of the laboratory

Sampling

- Strictly adhere to SOP for sampling.
- Ensure all equipment is clean and in working order.
- Record all conditions which applied during sampling.
- Take strict precautions to avoid contamination.

Sample receipt, storage and disposal

Proper storage of samples prior to analysis.

To ensure sample integrity

To minimize deterioration

Reporting of results

The final products of the laboratory are the data that it reports

Data should be comprehensively checked by an experienced analyst

A large, stylized logo consisting of the letters 'Q' and 'A' in a serif font, positioned inside a white arrow shape that points to the right. The arrow is set against a dark blue background with a grid pattern.

QA

Quality Control

Definition:

❑ A planned system of activities designed to provide a quality product

or

❑ The operational techniques and activities that are used to fulfill the requirement for quality

Quality Control Measure

There are two types of quality control

- Internal
- External

Internal Quality control

Quality control measures apply to each analytical test in the laboratory by use of:

- ❑ Blank
- ❑ Duplicate
- ❑ The quality control sample- use of Certified Reference Material (CRM) or Standard Reference Material (SRM)
- ❑ Blind test
- ❑ Internal standard / spike

Certified Reference Material (CRM)

Material or substances, one or more properties of which are sufficiently well established to be used for the calibration of a method, or for assigning values to materials.

CRM have five main uses

- ❑ Calibration and verification of measurement processes under routine conditions
- ❑ Internal quality control and quality assurance scheme
- ❑ Verification of the correct application of standardized method
- ❑ Development and validation of new methods of measurement calibration of other materials.

External Quality Control

- ❑ Inter-laboratory comparison study
- ❑ Proficiency test

Interlaboratory comparison studies

- ❑ Each laboratory uses a defined method to analyse identical portions of homogenous material.
- ❑ Mean also for assessing the performance characteristics of that method of analysis.
- ❑ May also be used to develop a standard method of analysis

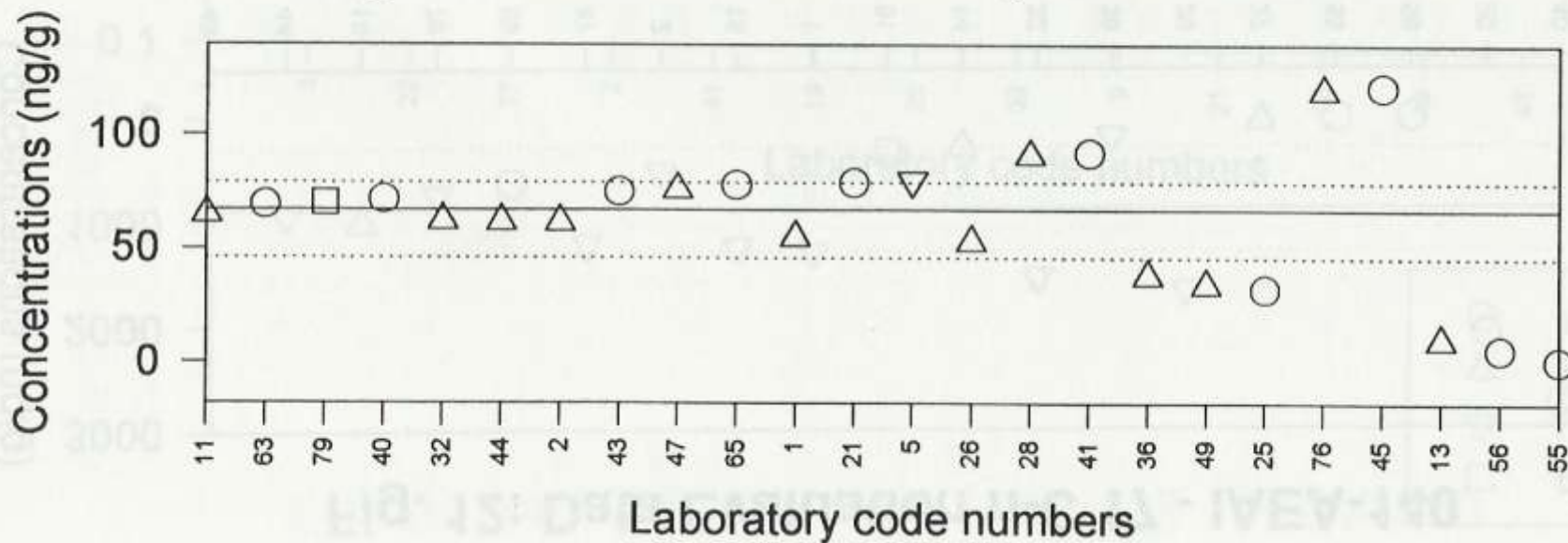
Problem with the Interlaboratory comparison study

- ❑ Insufficient number of participating laboratory. Should be more than 6 laboratory (insufficient degree of freedom)
- ❑ May be that a trial only request one result per analysis. If the participant does several assays but only submits what is considered the best this can distort the statistical evaluation.
- ❑ Accuracy of results – base on consensus

Example results of intercomparison study

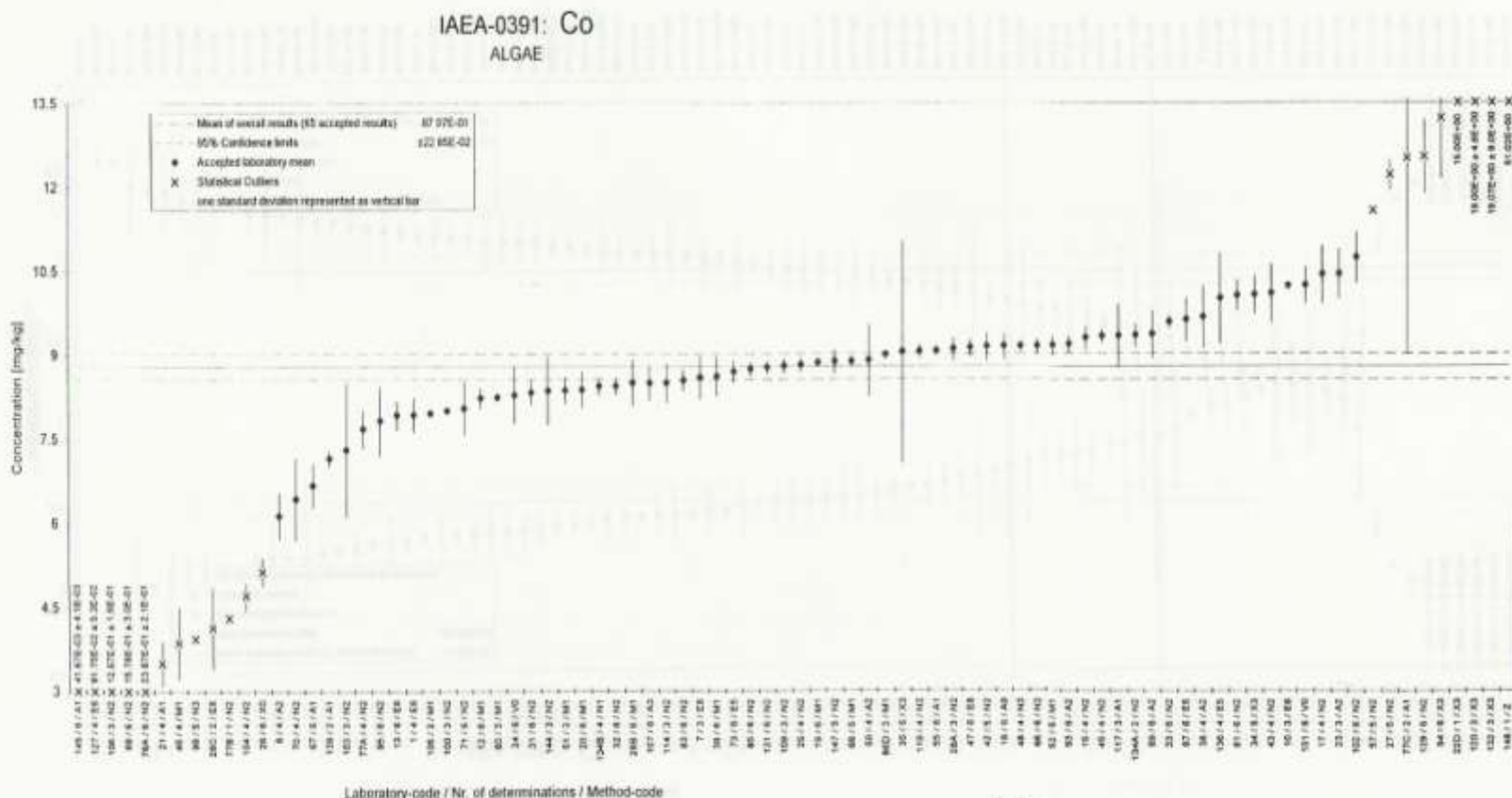
PAH compounds

Fig. 15: Data Evaluation Pyrene - IAEA-140



Example results of intercomparison study

Trace elements



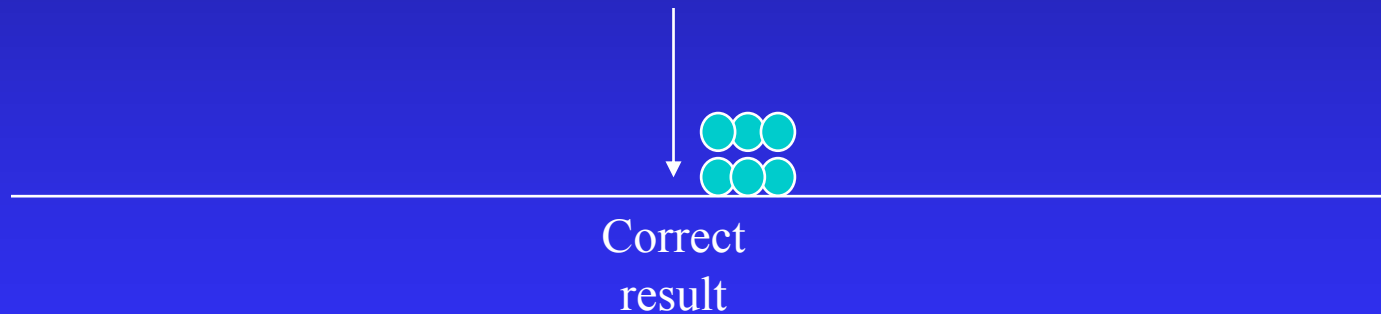
Proficiency Test

- Proficiency test (PT) – a system for objectively evaluating laboratory results by external means, and include regular comparison of a laboratory's results at intervals with those of other laboratories.
- PT – tools in quality assurance and quality control.

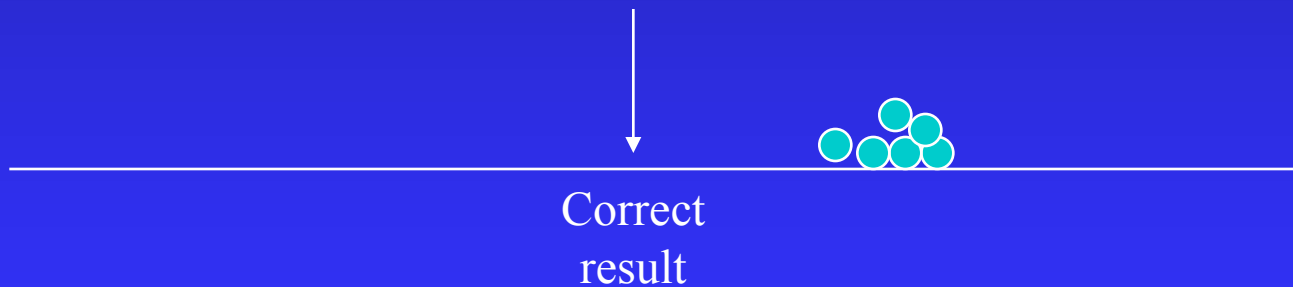
Objectives of Proficiency Test

✠ To encourage good performance, within the scope of this general aim a successful scheme must provide certain types of information for both the participants and the organizers.

- Accuracy: the closeness of agreement between a test result and the accepted reference value.



- Precision is due to random error, which cause the replicate results to differ from one another.



Proficiency Test Scheme

- ❑ The test samples are received from the organizer.
- ❑ Analysis will be carried out using the test method routinely practiced in the participating laboratory
- ❑ The results are then reported to a central organizer.
- ❑ Final reports will be sent to all participants after the evaluation process.

Types of Proficiency Test

2 types of proficiency test scheme:

- ❑ To measure the competence of a group of laboratories to undertake a very specific analysis. (i.e. analysis of specific analytes)

- ❑ To judge the competence of a laboratory across a field or type of analysis. (i.e. specific method or equipment for multi-element analysis)

Interpretation of Proficiency Test Reports

- ❑ To evaluate the performance of the results.
- ❑ The results obtained are most commonly expressed as z-scores
 - $Z < 2$ is considered satisfactory
 - $2 < z < 3$ is considered questionable
 - $z > 3$ is considered unsatisfactory

$$z = \frac{V_{analyst} - V_{target}}{\sigma}$$

Horwitz function to estimate standard deviation

$$\sigma_H = 0.02c^{0.8495}$$

U-test: to determine if the reported results differs significantly from the expected value at a given level of probability.

$$u_{test} = \frac{|V_{target} - V_{Analyst}|}{\sqrt{Unc_{Target}^2 + Unc_{Analyst}^2}}$$

Condition	Probability	Status
$u < 1.64$	$P > 0.1$	The reported results does not differ significantly from the expected value.
$1.95 > u > 1.64$	$0.1 > P > 0.05$	The reported result probably does not differ significantly from the expected value.
$2.58 > u > 1.95$	$0.05 > P > 0.01$	It is not clear whether the reported results differs significantly from the expected value.
$3.29 > u > 2.58$	$0.01 > P > 0.001$	The reported result is probably significantly different from the expected value.
$U > 3.29$	$P < 0.001$	The reported result is significantly different from the expected value.

Acceptance Criteria

Accuracy passes if:

$$\left| V_{target} - V_{analyst} \right| \leq 1.95 \times \sqrt{Unc_{Target}^2 - Unc_{Analyst}^2}$$

Precision passes if:

$$\sqrt{\left(\frac{Unc_{target}}{V_{target}} \right)^2 + \left(\frac{Unc_{analyst}}{V_{analyst}} \right)^2} \times 100\% \leq \sqrt{\left(\frac{Unc_{target}}{V_{target}} \right)^2 + \sigma_H^2} \times 100\%$$

CONCLUSION

- Both accuracy and precision are used to qualify the quality of analytical data.
- It is important to assess the laboratory performance through either interlaboratory study or proficiency test.
- Proficiency test results is acceptable as prove of the applicability of an analytical system by laboratory accreditation scheme based on ISO17025