



## INTERLABORATORY TESTING PRACTICES BENEFITS AND THEIR IMPLEMENTATION

<sup>1</sup> National Institute of R&D for Machines and Installations Designed to Agriculture and Food Industry (INMA), Bucharest, ROMANIA

**Abstract:** Proficiency testing (PT) and inter-laboratory comparison schemes (ILC) provide laboratories with a useful tool for increasing their testing and calibration standards. These two interlaboratory testing practices are often neglected since they are regarded just as a requirement to fulfill and not an approach for continuous development. Proficiency testing provides for an independent assessment of laboratory findings, in comparison to reference values or the performance of other laboratories. A positive evaluation is a confirmation of the laboratory ability to show high technical competence and provide credibility in the accuracy, reliability, and security of the test data it delivers. This paper aims to analyze Inter-laboratory testing practices, focusing on their benefits and their implementation process.

**Keywords:** proficiency testing, laboratory performance, quality control tools

### INTRODUCTION

Analytical data is used today to make economic, legal, or environmental management choices, therefore the results of analytical determinations are considered highly significant. It's critical that these metrics to be precise, reliable, cost-effective, and reasonable. Experimental laboratories play an essential role, since they are involved in the generation of scientific information, which in many situations leads to critical decisions or other broader evaluations. It is fundamental to assure the quality of the data supplied from each laboratory since scientific findings must be based on reliable and internationally comparable data (Voiculescu et al., 2013).

The need for a high level of confidence in laboratory performance is critical not only for laboratory practices and for their customers, but also for other interested parties such as regulators, laboratory accreditation bodies, and other organizations. As a result, proficiency testing is becoming increasingly important. In the domain of quality assurance of laboratory results, proficiency testing is an essential technique to achieve the legal performance standards (Boley, 2000).

Proficiency testing (PT) is a method for measuring the correctness of analytical data provided by laboratories for specific measures on a regular basis. It is the laboratories responsibility to select the most appropriate scheme and to check and evaluate the quality of the PT provider. The time and effort required can be costly, especially for laboratories performing many different tests, so selecting the most appropriate PT scheme is very important.

Laboratory analysis are performed for a variety of purposes, but most commonly used reason is to ensure that a product has been made in accordance with standards and regulations and it is safe to be distributed to the market. It is therefore critical that the analysis results to be trusted in terms of both accuracy and repeatability.

Using effective Quality Control Tools to monitor the classification of the data regarding foods can aid prevent acceptable products from being destroyed and non-

conforming product from being distributed on the market. Quality Control tools that can be implemented in the laboratory practices should contain an external reference point over which the lab has no direct control. External quality controls may include proficiency testing (PT) and reference materials (RM) supplied from an external and independent quality source. The level of performance of laboratory measurements must be monitored as part of the national and international regulations for the competence of testing and calibration laboratories and accreditation process.

In order to remove the trading barriers worldwide it is necessary to establish foundations for free commerce throughout the world.

Therefore, agreements promoting the growth of mutual acceptance of international conformity assessment systems must be implemented. These agreements are based on mutual trust and are the result of a long-term collaborative partnership. They consist of three major elements: harmonization of accreditation criteria and operating procedures, a comprehensive program of inter-laboratory comparisons, and assessments by international team of accredited experts (Basic et al., 2010). The most important elements that must be defined in the case of establishing such procedures are: the concepts for designing a laboratory calibration system, the calibration processes and operating instructions required, the choice of traceable values to be calibrated, the calibration precision to be used, and the calibration intervals to be determined (Koch et al., 2001).

### MATERIALS AND METHODS

Inter-laboratory investigations are useful for a variety of reasons in terms of determining measurement quality. They enable the validation of measuring techniques, the assessment of individual laboratories' competency, the estimation of measurement uncertainty, and the certification of reference materials in a wide range of application sectors. Inter-laboratory comparisons (ILCs) also known Measurement comparisons, are the most common method of determining the compatibility of testing across various laboratories or measurement systems. As a result, they serve

as a tool for determining the alignment with national and international standards. These techniques clarify important elements in the operation of laboratories such as the measurement traceability when transferring the information from National laboratories to secondary laboratories, the effectiveness of their accreditation processes (when accrediting laboratories for new types of analyzes), and the operators competence and equipment (Galliana et al., 2019).

## RESULTS

Inter-laboratory tests have the benefit of allowing measurements previously only possible with the technology and competence of a national extremely sophisticated laboratory to be regularly expected in private industrial laboratories. Inter-laboratory studies have been employed as an independent quality control by the laboratory community for many years.

Many of chemical measurements are taken to inform both consumers and decision makers about food safety, health, and environmental protection. The global market, requires precise and trustworthy actions in order to reduce technological trade obstacles. Reliable laboratory analysis depends to a large extent on several elements such as: qualified personnel approved and validated procedures, extensive quality systems, and traceability to appropriate measurement standards. In addition the increasing in the use of standards and standardized methods, as well as laboratory accreditation, demonstrates that the minimum quality requirements are ensured. At the regional and international levels, using comparability between is a useful technique that helps improving the measurement standards.

### — Proficiency testing

Inter-laboratory studies, or collaborative studies, are more elaborated studies where several laboratories analyses the same material with a specific purpose.

There are three basic categories that may be recognized depending on the study's focus (Hogan, 2019; ISO 5725-2:2019):

- ≡ Collaborative trials or method-performance studies evaluate a method's performance characteristics. These are known as accuracy experiments, and they take into account the precision and correctness evaluations from the inter-laboratory testing. Precision experiments for the evaluation of repeatability and reproducibility are described in the ISO 5725-2 guideline. The second component of accuracy is trueness, which quantifies the measurement method bias in an inter-laboratory environment.
- ≡ Laboratory-performance (proficiency studies) orient towards the laboratory with the goal of determining the laboratory's level of proficiency. Test samples that are known or have been allocated, are assessed by a group of laboratories in certain investigations, also known as round robin studies. The laboratories utilize the approach that is currently in use.

- ≡ Material-certification studies have the goal of providing (certified) reference materials. A consortium of laboratories analyzes a sample, preferably using multiple methods, to estimate the most likely concentration of a certain substance with the least amount of uncertainty.

Proficiency testing is a technique used for inter-laboratory evaluation that verifies laboratory testing performance. Participation in proficiency testing schemes and programs offers laboratories the possibility of evaluating and demonstrating the reliability of the results they provide.

In addition, these requirements are mandatory for all certified and applicant (for accreditation) laboratories. They have to successfully complete a proficiency testing program in their specific area of testing. Inter-laboratory comparisons are frequently utilized for a variety of applications and are becoming more popular across the world.

A Proficiency Testing (PT) scheme is a technique for objectively reviewing laboratory findings by external means, which involves comparing a laboratory results with those of other laboratories, at regular time intervals. This is accomplished by providing homogenous test samples to participating laboratories on a regular basis for data analysis and reporting. A Proficiency Testing scheme has the main goal is to assist the participating laboratory in assessing the correctness of its test results.

The material under testing, the testing method that is being used, and the number of testing laboratories participating to the Proficiency Testing all influence the testing methodologies. These methodologies must all have the ability to compare the results produced by one testing laboratory with those provided by other testing laboratories. One of the participating laboratories may responsible for supervising and coordinating certain programs.

### — Benefits Inter-Laboratory Comparisons/Proficiency Testing (ILC/PT)

As earlier discussed inter-laboratory comparisons (ILC) need two or more laboratories to organize, conduct, and evaluate tests on the same or comparable samples under pre-determined conditions, while Proficiency testing (PT) is a method of evaluating participant performance by comparing results from different laboratories. Participation in PT activities provides laboratories with several benefits in addition to achieving ISO/IEC standards.

Besides the accreditation requirements, different parties, such as regulators, direct customers, indirect customers, and professional bodies, have a strong interest in the laboratory Proficiency Testing. In addition, external stakeholders, as well as laboratory employees and management, gain trust as a result of successful involvement in ILC/PT operations. Achievement of proficiency testing provides an external assessment of the laboratory testing or measuring skills, which complements the laboratory's internal quality control operations. When a laboratory agrees to have its testing or measurement performance reviewed using PT, it gives interested parties more credibility and respect.

Another important advantage is that laboratories can compare their performance to that of other participating facilities using Inter-Laboratory Comparisons and Proficiency Testing data. Furthermore, ILC / PT may be used to compare analytical data gathered using various methodologies, contributing to the quality of services in the long-term. The laboratory may compare new methods to current procedures or conduct a trial run of a new or irregularly executed process in the laboratory. ILC / PT findings can also help validate a method by proving its precision and accuracy and giving useful information for estimating measurement uncertainty. LC and PT efforts can be employed to demonstrate laboratory advanced capabilities, validating competent technique performance, or to compare operator capabilities, supplying operator repeatability data, for the measurement of uncertainty estimations. Confirming competent performance offers confidence to laboratory management with assurance that the laboratory's performance is adequate, or notifies the management to possible difficulties in certain areas of the laboratory.

Participation in ILC and PT offers management with external monitoring of the management system's continued effectiveness in regard to key tests or metrics. The review and analysis of proficiency testing results might also result in additional people education, training, and competence monitoring. Participation in specific ILC and PT may also be utilized to assign the certified value and to assess the uncertainty of this value for certified reference materials. A well-designed PT strategy helps guarantee that the laboratory gets the most out of PT involvement and the data provided by PT activities.

When novel measurement technologies are developed, that are based on new concepts with application in the field of environmental protection or agriculture, it is needed a testing methodology performed with the proper equipment in several conditions and for several laboratories. There is a need for research organizations to adopt quality management system in research testing laboratories as an asset, to improve not also the management, but also the technical and scientific competence (Nenciu et al., 2021; Mircea et al 2020). If a laboratory is required to participate in an inter-laboratory comparison of a calibration "type" that covers a wide range of instruments / quantities there should be a four-year plan that addresses a different calibration each time (Softic et al., 2012). Only in the event that a calibration service from a certified laboratory is unavailable, services provided by an external calibration laboratory without certification are permitted. When no accredited calibration laboratory services are available for highly specialized test equipment, the equipment may be calibrated by the manufacturer as long as the used calibration standards are traceable to national or international units of measurement, the traceability chain is recognized, and an estimate of measurement uncertainty is included on the calibration certificate (Walczak-Zlotkowska et al., 2016; Nenciu et al., 2014).

For quality testing, measuring equipment accuracy and constraints/tolerances and traceability are critical matters. Measurement traceability refers to the value of measurement findings or the value of a standard in relation to existing references, which is maintained by an unbroken chain of comparison of all these uncertainties. Traceability exists only when properly scientific records indicate that the measurement is continuous and validated by findings, for which entire measurement uncertainty has been determined (Zaimovic-Uzunovic, 1999). The rank of the operations carried on the apparatus, as well as the variable metrological parameters and rankings for the laboratory to which the traceability requirement applies, must be specified during the procedure. Because all measurements are time-dependent, traceability identifies the measurement method and related measurement uncertainties for the present measurement result, which must be preserved in the traceability documentation. Because measurement uncertainty is the core of creating traceability, it is very important for building methodologies for assessing measurement uncertainty under various measurement settings (Ehrlich, 1998).

There is widespread agreement on the significance and benefit of testing laboratories implementing a Quality Management System (QMS) to support their work, whether it is industrial or research-based. Due to the unique nature of their work, laboratories involved in R&D testing have unique challenges in implementing a QMS. Researchers and professionals have long debated whether or not a Quality Management System (QMS) should be implemented in research testing facilities (Martinez-Perales et al., 2021; Lemes et al., 2012).

#### — Elements to be followed by the parties participating to the tests

There are a few key principles that all of the parties involved must follow (Boley, 2000):

- ≡ The Proficiency testing scheme in which a laboratory participates should resemble as closely as possible the laboratory's routine work in terms of test samples, substances and levels; any variations should be noted and accounted for;
- ≡ Performance in a PT scheme should be placed in the correct context and in the proper perspective;
- ≡ Wherever feasible, the performance of a laboratory across numerous rounds of a PT scheme should be examined.
- ≡ The documentation and statistical protocol should always be read, in order to better understand how the scheme operates
- ≡ If needed, should communicate with the scheme coordinator to get a better understanding of the scheme and how it works.

#### CONCLUSIONS

The correct use and interpretation of Proficiency testing (PT) scheme results is complex and requires the evaluation of a large amount of data. As a result developing a good understanding of proficiency testing, in order to use the

information in a more sophisticated and suitable manner is sometimes difficult for laboratory operators, particularly for those with a relatively limited technical background. It is therefore essential that interpretation of proficiency testing scheme to be carried out and interpreted in an appropriate manner. This is important not only for laboratory personnel and management, but also for the entities who use their results, including accreditation bodies, public institutions, partners and the laboratory customers.

As part of an overall quality plan, a frequent independent examination of a laboratory technical performance is advised as an important way of verifying the validity of analytical measurements. Independent proficiency testing (PT) programs are a typical way to this evaluation. A PT scheme is a technique for objectively reviewing laboratory findings by external sources, which includes comparing a laboratory's results with those of other laboratories at regular intervals.

However, as a quality assurance technique for laboratories, proficiency testing is becoming increasingly important. The performance of laboratories evaluated in Proficiency Testing systems is increasingly being applied as a measure of laboratory competence and quality, especially by accreditation agencies. It is critical for laboratories to have detailed knowledge of the scope, range and availability of proficiency testing programs in the regions they operate. As a result, they will be capable of making appropriate decisions about the scheme where they should participate, in order to obtain the best results. As a result, laboratories must establish a solid understanding of proficiency testing, including what the goal are and how the evidence from proficiency testing schemes must be reviewed and used. This is essential not just for scientific employees and management, but also for those who employ the laboratory's results, such as accreditation authorities and customers.

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Faculty of Engineering Hunedoara,  
5, Revolutiei, 331128, Hunedoara, ROMANIA  
<http://acta.fih.upt.ro>