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Yakovlev Viacheslav

Specialist in environmental engineering and monitoring,

pollution control and regulatory compliance

STANDARDIZATION OF ENVIRONMENTAL MEASUREMENTS IN UKRAINE: THE ROLE OF PRIVATE LABORATORIES IN THE TRANSITION TO EUROPEAN STANDARDS

Summary. *Ukraine is in the process of adapting its environmental and sanitary legislation to European Union standards, while simultaneously facing the consequences of war and the need for rapid assessment of environmental damage. Against this background, the importance of properly conducted environmental measurements—noise, air quality, water quality, and microclimate—is increasing not only for public authorities but also for the private sector.*

This article examines the challenges of standardizing environmental measurements in Ukraine, with a focus on the role of private laboratories and small mobile measurement services. Based on the practice of a family laboratory that has been carrying out at least 60 orders per month for more than eight years, key methodological and organizational issues are analyzed: the choice of regulatory framework (national standards, WHO recommendations, and EU documents), requirements for equipment and calibration, ensuring comparability of results, digitalization of protocols, and integration into the overall monitoring system. Particular attention is paid to the influence of European trends and international projects (including UN programs aimed at strengthening environmental monitoring in Ukraine) on shaping requirements for private laboratories.

Key words: *environmental monitoring, Ukraine, private laboratories, standardization, air quality, noise, water quality, European standards, measurement methodology, accreditation.*

Introduction. In recent years, environmental monitoring in Ukraine has been under dual pressure. On the one hand, the country is moving toward harmonization of its legislation with that of the European Union: new requirements for air quality, water quality, noise, and environmental management systems are being introduced, and greater attention is being paid to data transparency. On the other hand, the war has caused large-scale environmental damage that requires rapid assessment and documentation. International organizations, including UNDP, are supplying Ukraine with mobile mini-laboratories and equipment for recording environmental damage, standardizing evidence-gathering methodologies and bringing them closer to European and international practices.

Against this backdrop, the role of private environmental laboratories and small mobile measurement services is increasing. They operate where large state monitoring systems physically cannot keep up—at the level of individual sites such as apartments, offices, small industrial facilities, schools, and private clinics. Practice shows a steady flow of orders (at least 60 clients per month) for measurements of noise, air quality, water quality, and microclimate.

However, without standardization of methodologies, equipment, and reporting, even high-quality measurements lose part of their value: they are more difficult to use in courts, during inspections, in comparative analyses, and in planning measures to improve environmental conditions.

The purpose of this article is to show how private laboratories can be integrated into the overall system of environmental monitoring in Ukraine and the transition to European standards, based on the principles of standardization and data quality.

1. Regulatory Context: Between National Standards and European Benchmarks

The regulatory framework for environmental measurements in Ukraine includes several levels:

National sanitary and building standards.

These define permissible noise levels in residential and public buildings, requirements for indoor microclimate, parameters of drinking water, and the working environment. These documents remain the main legal basis for inspections and court proceedings.

World Health Organization recommendations.

Updated WHO global guidelines on air quality (PM2.5, PM10, NO_2, etc.) and noise in the European Region are often stricter than national standards and are increasingly used as benchmarks in assessing health risks.

European Union documents and reports of the European Environment Agency.

These set target indicators for reducing exposure to polluted air and noise, as well as requirements for monitoring systems. These approaches are important because Ukraine has declared a course toward gradual integration into the European environmental space.

The technology and monitoring market.

According to analytical companies, the global market for environmental monitoring solutions is estimated at approximately USD 22.7 billion in 2024, with a projected increase to USD 41.8 billion by 2034 (CAGR of about 6.3%). In parallel, the air quality monitoring systems market is developing and may exceed USD 11–12 billion by 2034.

For a private laboratory, this background means the need to operate simultaneously within several coordinate systems: ensuring the legal validity of

measurements within national standards, while also being able to interpret results through the lens of WHO recommendations and future European requirements.

2. Challenges Facing Private Laboratories in a Transitional Period

The practice of private (family-run) laboratories reveals several key problems related to standardization.

2.1. Fragmentation of Regulations and Methodologies

Different regulatory documents often propose different approaches to the same parameters, including:

- discrepancies in permissible levels of noise or pollutants;
- differences in sampling methodologies and measurement conditions;
- the absence of direct guidance for certain parameters (for example, national standards for fine particulate matter PM2.5 may be less developed than WHO or EU recommendations).

Under such conditions, laboratories must explain to clients which standards are used as the basis for conclusions and clearly distinguish between legally binding criteria and health-based reference guidelines.

2.2. Equipment and Metrological Framework

A key requirement for a private laboratory is to measure no worse than a public (state) laboratory. This implies:

- the use of instruments with known metrological characteristics and the possibility of regular verification;
- maintaining documentation on verification and calibration;
- rejection of methodologically incorrect devices (those without passports/certificates or verification support).

The development of the technology market simultaneously simplifies and complicates this task. On the one hand, more solutions are available; on the other,

the risk of using "semi-professional" devices without clear metrological validation increases.

2.3. Comparability of Results

Without unified approaches to the selection of measurement locations, timing, averaging methods, and data presentation, results from different laboratories are difficult to compare. This is critical:

- in court disputes, when parties submit reports from different organizations;
- in dynamic monitoring ("before" and "after" renovation or equipment installation);
- when attempting to use private laboratory data in regional or national statistics.

2.4. Wartime Context and Limited Resources

In wartime conditions, part of the monitoring infrastructure is damaged or overloaded with tasks related to documenting war-related environmental damage. International projects, such as the provision of mobile environmental laboratories to the State Environmental Inspectorate, partially compensate for this deficit but do not meet the needs of all sites.

Private laboratories find themselves in a situation where demand is increasing while resources remain limited—another strong argument in favor of standardization, as it allows more reliable work to be carried out with the same resources.

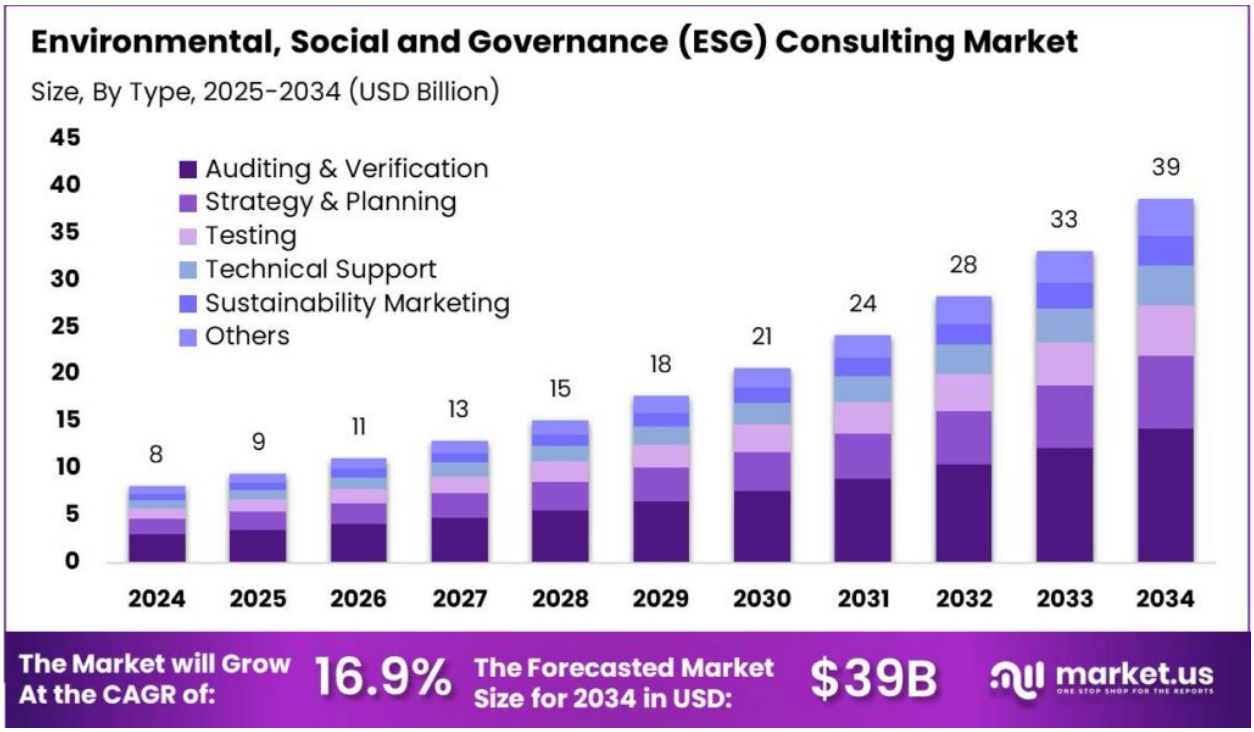


Fig. 1

3. Practical Principles of Standardization in a Private Laboratory

Even in the absence of a single mandatory overarching system for all private actors, the development of internal standards can significantly improve the quality and relevance of results.

3.1. Unified Measurement Protocols

Even a small laboratory can develop and implement:

- standard layouts for measurement points for major types of sites (apartment, office, workshop, surrounding area);
- standardized time regimes (day/night, peak load periods, work shifts);
- templates for describing conditions (windows open/closed, equipment in operation, number of people present).

This makes results reproducible and understandable both within the team and for external users—clients, lawyers, and inspectors.

3.2. Data Quality Management

Key elements include:

- two-stage report review (performer + internal reviewer);
- preservation of raw data and measurement conditions to allow reanalysis;
- procedures for identifying anomalous values (for example, results that clearly fall outside the logical pattern of a measurement series).

Even with a small staff, these practices are feasible if formalized through internal regulations.

3.3. Integration of European and International Reference Frameworks

Even when national standards remain the only legally binding ones, clients are increasingly interested in the international context. A practical approach includes:

- clearly separating sections in reports into "compliance with national standards" and "comparison with WHO/EU recommendations";
- presenting both reference levels for key parameters (for example, a national limit and the WHO guideline for PM2.5 or noise);
- providing explanations of the nature of risk: legal (non-compliance with a standard) versus medical/sanitary (increased probability of adverse effects).

This reporting style helps laboratories prepare for future harmonization while remaining fully relevant within the current legal framework.

4. Digitalization as a Tool for Standardization

Digital tools are becoming a natural extension of methodological work.

4.1. Electronic Forms and Databases

The use of electronic forms for field measurements (tablets, laptops) makes it possible to:

- standardize the structure of collected data;

- eliminate missing key fields;
- automatically record date, time, and coordinates.

A shared data repository enables:

- internal analytics (typical violations, spatial distribution, seasonality);
- rapid access to archived measurements for reanalysis and comparison.

4.2. Continuity and Data Exchange

Digital formats facilitate interaction with other participants in the monitoring system, including:

- transfer of anonymized data to universities and research centers;
- participation in joint projects with municipal or regional monitoring systems;
- integration into future national-level data exchange platforms.

Market forecasts for monitoring solutions indicate growth in the number of connected environmental monitoring devices from 26.6 million in 2024 to 89.5 million by 2034, confirming the trend toward a "networked" model of environmental control. Under these conditions, compatibility of data formats and protocols becomes not only a technical issue but a strategic one.

5. The Role of Private Laboratories in an Evidence-Based Environmental Policy System

Private laboratories are not merely executors of commercial contracts. Given a sufficient volume and quality of data, they can:

- provide "fine-tuning" of the national monitoring system through localized measurements;
- signal typical problem areas (neighborhoods with systematic noise pollution, premises with chronically poor indoor microclimate);
- support the development and updating of regulations based on real-world data rather than solely on theoretical calculations.

In the context of Ukraine, where the war has created numerous new sources of environmental risk, the potential of private laboratories is particularly significant. Their data can complement the work of governmental and international institutions documenting war-related damage and assessing environmental conditions.

Conclusion. Ukraine's transition to European standards in environmental protection and public health is impossible without reliable, comparable, and legally robust data. Private environmental laboratories and small on-site measurement services play an important role in this system—at the level of specific facilities, where real problems affecting people and businesses are addressed.

Standardization is the key to ensuring that the results of their work:

- are recognized by courts and regulatory authorities;
- can be used for analysis and planning;
- fit into national and European monitoring systems.

The experience of a family-run laboratory that has operated on the Ukrainian market for more than eight years and serves at least 60 clients per month demonstrates that even with limited resources it is possible to establish internal standards for methodologies, equipment, data processing, and reporting, as well as a digital framework for data storage and analysis.

In the context of war and post-war recovery, when attention to environmental quality is only increasing, such laboratories become not merely service providers but active contributors to the formation of evidence-based environmental policy. Standardized measurements at the level of apartments, offices, and small industrial facilities collectively form the foundation for a safer and more sustainable national ecosystem.

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