

The role of metrology and its impact on modern society

Metrology, also known as a science of measurement, has been defined by the International Bureau of Weights and Measures (BIPM), the international roof organisation of scientific metrology, as “the science of measurement, embracing both experimental and theoretical determinations at any level of uncertainty in any field of science and technology“. This description matches a wide range of industries, technologies, and applications it provides in modern world.

Metrology is present in almost every segment of human action and people usually unknowingly use or obey metrological requirements to be able to communicate with each other, trade, travel, compare measurement results and generally exchange data with mutual understanding. It is impossible to overemphasize the importance of metrology and understanding its principles for achieving any technological and scientific progress.

“When you can measure what you are speaking about, and express it in numbers, you know something about it; but when you cannot express it in numbers, your knowledge is of a meagre and unsatisfactory kind” William Thompson (Lord Kelvin): Lecture on "Electrical Units of Measurement" (3 May 1883)

Several examples from industry and technology include:

Smart grids for electrical power - Smarter grids will enable integration of renewable energy sources and electric vehicles into Europe’s and global electricity distribution networks. Smart grids require new measurement infrastructure supported by strategic coordination and implementation of metrological principles. Metrology and standardization play a key role in addressing these challenges and provide coherent approach needed to meet stakeholders’ technological and strategic needs.

Energy and Petrochemical industry - this industry relies on metrology to keep their machines up and running. To make this happen, power plants implement laser alignment as part of their preventive maintenance program. By using this method we can assure that rotating equipment is correctly aligned (within acceptable tolerances). Metrology can also be used by the original equipment manufacturers (OEMs) to calculate tolerances using specialized tooling before installation and testing. With 3D measurement technology you can gather data in dimensional changes, flange locations, concentricity, equipment interferences, and other key areas in need of inspection on your turbine or rotating equipment. Less downtime leads to more efficiency, efficiency translates in less damage on bearings, seals, couplings or a bend shaft, less damage increases the lifetime of the machines, saves money and reduces power loss; all this means more energy and more cost-effective production to supply the global energy consumption.

Automotive and Aerospace industry - analysis of large volume parts, inspecting turbine blades, fixing inaccuracies in geometry and positioning to proper car assembly, more efficient sensor systems and procedures.

Automation and Manufacturing industry - most of the processes at manufacturing plants are automated, which means controlled by machines. These machines are calibrated and programmed according to specific parameters to fabricate goods on a production line. The machines are capable of

measuring quantities, lengths, weights, time, environmental conditions, etc. The accuracy and precision of those measurements are crucial to comply with the safety and quality requirements for public use or consumption. For example: the dosing of drugs on a pharmaceutical plant, food safety in a processing plant, or the reliability of the equipment in healthcare operations at a hospital.

Environment protection – Metrology helps addressing key challenges in the need to protect the environment and safeguard our quality of life, whilst ensuring sustainable economic growth within demanding environmental legislation. Managing and protecting the environment requires robust and reliable measurement data to assess and monitor environmental parameters whether for assessing climate change or pollution emission trends. Scientists studying climate change base their findings on data gathered from satellite borne instruments, and terrestrial networks for monitoring air quality. National and international agencies rely on this data to ensure that environment treaties and regulations are both well-designed and enforced effectively. Carbon accounting schemes and other regulatory measures for safeguarding the environment also require reliable data based on accurate measurements of pollutants potentially present in the environment at part per billion levels.

Medicine – A basic understanding of metrology is essential for the daily practice of medicine. In intensive care, clinical decision-making is often determined by measurements of physiological and other variables to an extent unrivalled by most other medical specialties. Therapeutic success and ultimately outcomes in the critically ill depend on the correct interpretation of such measurements. Therefore, physicians should be aware of metrological concepts and understand the limitations and constraints. In addition, the interactions between medicine and other scientific disciplines mandate a common language. Since international consensus definitions exist, we must use them and promote them in the medical research and literature.

Protection of end-users & conformity assessment of products and services – In every country, no matter its size or its level of development, it is mandatory to watch over the health and safety of its citizens, the preservation of the environment, and fair trade. Current globalisation processes are making available a wide range of goods and services, either produced locally or imported. All these require the establishment of laws and rules, standards and technical regulations, and the implementation of the mechanisms needed for compliance. Usually, to ensure compliance demands carrying out quantity measurements of diverse types, and the availability of instruments, procedures or systems of measurement capable of ensuring accuracy and reliability of the results. This requires a national system that can support quantity measurements within the legal framework of the country – that is, a legal metrology system.

WTO – TBT Agreement, Article 6: Recognition of Conformity Assessment by Central Government Bodies – Article 6.1.1: “adequate and enduring technical competence of the relevant conformity assessment bodies in the exporting Member, so that confidence in the continued reliability of their conformity assessment results can exist; in this regard, verified compliance, for instance through accreditation, with relevant guides or recommendations issued by international standardizing bodies shall be taken into account as an indication of adequate technical competence.”