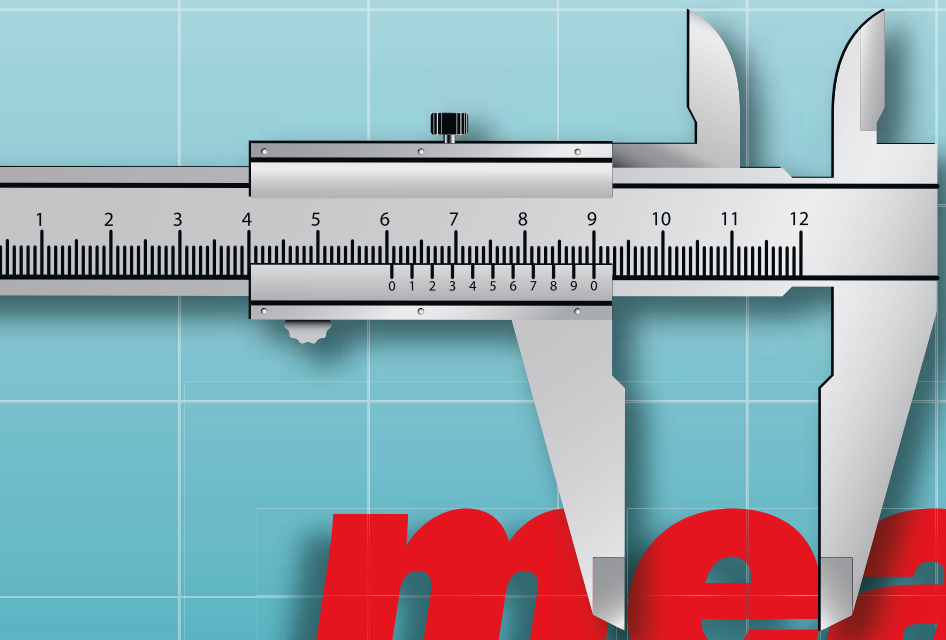


T measur qu

Mehrdad Kamali, CQP MCQI, MSc, explains why measurement and testing is crucial for the quality control of products and services

As quality professionals, how much do we need to know about measurement and testing? There is plenty of published information on quality assurance, quality control and quality systems; however, no matter how robust our quality assurance is, without solid benchmarks for products and services, we will not be able to accurately measure our success. Even if the whole process is left in the hands of a specialist, there will be a need for an overall understanding of the measurement subject or control.

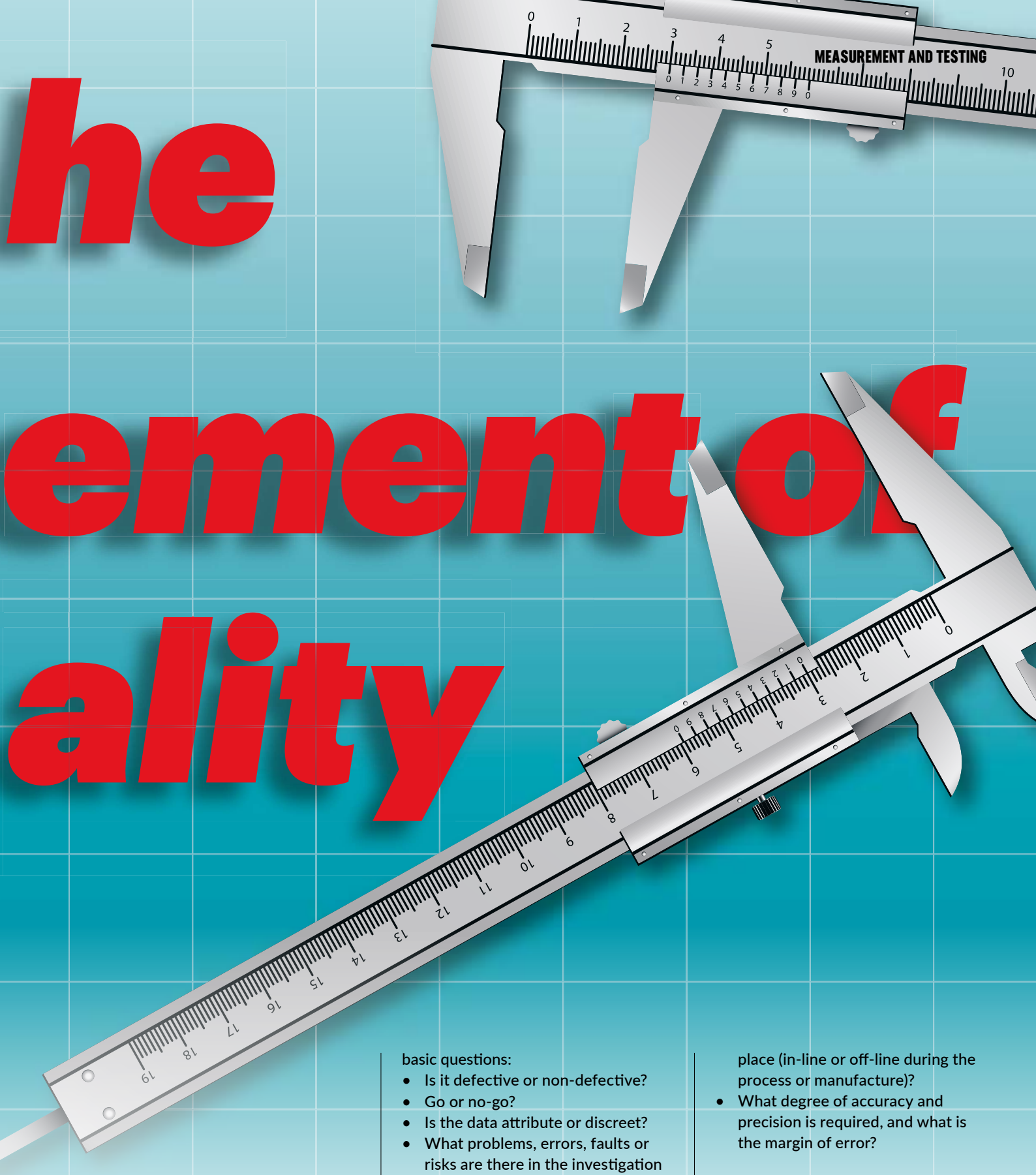
On writing this feature, I reflected on the quote by Galileo Galilei: "Measure what can be measured, and make measurable what cannot be measured".

How to carry out the measurement

After planning, measurement is a major element of quality control. Any work is still incomplete without planning, data collection, data analysis and turning this analysis into useful information. When planning, we need to establish why there is a need for measurement, and what actions will follow based on the measurement. It is only then that we can logically start thinking about how to measure.

The good news is that we don't need to reinvent the wheel. The fundamental requirements of testing and measuring remain unchanged, and systems have been developed by thousands of other organisations that have faced similar issues. When we absolutely must create a new way to measure, we are in for some hard work. In that

he ement of ality



case, it is crucial to know exactly what information we need, the correct decision and what action will be taken based on this information, then start creating a measurement method.

To proceed, we need to answer some basic questions:

- Is it defective or non-defective?
- Go or no-go?
- Is the data attribute or discreet?
- What problems, errors, faults or risks are there in the investigation to minimise?
- How would you establish a (false) alarm and its severity?
- How often should we measure?
- What equipment is required?
- What sample size is required?
- How will we analyse and present the final information and to whom?
- When and where should it take place (in-line or off-line during the process or manufacture)?
- What degree of accuracy and precision is required, and what is the margin of error?

We also need to clearly define the responsibilities for creating the measurement plan and assuring it works as intended. It is also important to identify who will be managing the plan and inspection on an ongoing basis, and what skills they need. There is news of firms facing a talent shortage. To start with, a quality ▶

professional needs in-depth knowledge of Geometric Dimensioning and Tolerancing (a system for defining and communicating engineering tolerances), as well as how this is incorporated into quality assurance processes. As measurement equipment is continually improving and becoming more sophisticated, the challenge is training and employing people who can work with it and handle the data. This is a more pronounced issue in certain industries than it is in others.

The essential requirement in all of the above is the traceability of the measurement results. This is demonstrated through a documented and unbroken chain of calibrations, each contributing to the measurement uncertainty. It is up to the organisation that performed the measurement to prove through calibration documents that traceability is linked to organisations such as the National Physical Laboratory (NPL) in the UK or the National Institute of Standards and Technology (NIST) in the US.

In search of certainty

Certainty is an elusive commodity. An agile, data-driven organisation can absorb, react to and mitigate the impact of measurement data if it is aware of the level of uncertainty.

The adoption of digital technologies – often referred to as Industry 4.0 or the fourth industrial revolution – within companies is helping them to reduce their costs and stay ahead of their competition. To benefit fully, businesses will need to step up all levels of their training and data collection.

The application of data analytics technology can provide the ability to interrogate the collected data and to maximise the precision and accuracy of information.

This information will assist in monitoring product, productivity, benchmarking, performance, improving workflow, identifying and acting on under/over-utilised equipment, waste and preventive maintenance.

When collecting the data, it is important to know that a measurement result is complete, and only when it is accompanied by a statement of the associated uncertainty. To understand uncertainty, please refer to *A Beginner's Guide to Uncertainty of Measurement* (bit.ly/3oph9UR) by Stephanie Bell, published by NPL.

Once we are happy with the data, we then need to analyse and transform it into information usable for our purpose. John Wilder Tukey, an American mathematician, described data analysis as: "Procedures for analysing data, techniques for interpreting the results of such procedures, ways of planning the gathering of data to make its analysis easier, more precise or more accurate, and all the machinery and results of (mathematical) statistics, which apply to analysing data."

Data modelling and data visualisation such as formulas, tables, graphs, etc, will assist in the communication.

It is also important to apply techniques such as Measurement System Analysis and Statistical Process Control, which are employed to assist in accuracy, certainty and prevention of defects getting into the next process.

Finally, like any other project, consider the costs. Obviously, all the activities discussed above have an associated cost that needs to be considered beforehand, to make sure that it does not run over-budget.

All of the above is a consideration for measuring a single parameter. A more complex measure of product or service requires further discussion.

In conclusion, this activity is a collaboration between the designers who need to have an understanding of how each parameter is going to be measured, and the manufacturers, service providers, suppliers and quality personnel who need to understand the importance of the parameter and are trained in the equipment that is used for this purpose.

What has been examined here so far is by no means the only consideration, but it emphasises the fact that although quality assurance and quality systems are essential failure prevention tools, quality control tools, methods and techniques remain the proof of the pudding! There is so much more to know and so much to learn.

We only need to look at recent product failures from leading organisations to realise that data can be used as evidence in courts when it comes to customer satisfaction with all its reputational outcome. ■

"An agile, data-driven organisation can absorb, react to and mitigate the impact of measurement data, if it is aware of the level of uncertainty"