

OPTIMIZATION OF REQUIREMENTS FOR METROLOGICAL SUPERVISION PROCESS IN INDUSTRY OR LABORATORY

Asta Meskuotiene¹, Justina Dobilienė², Simas Joneliūnas³

¹KTU Institute of Metrology, Kaunas, Lithuania, Asta.Meskuotiene@ktu.lt

²KTU Institute of Metrology, Kaunas, Lithuania, Justina.Dobilienė@ktu.lt

³KTU Institute of Metrology, Kaunas, Lithuania, Simas.Joneliunas@ktu.lt

Abstract: This paper presents comprehensive attitude to measurement process. Detailed model of metrological supervision can be applied in every industrial enterprise that seeks reliable results solving measurements traceability problem. Optimization of measuring instruments characteristics and created model of metrological supervision can ensure efficient use of these devices in technological process or laboratory. This research is the basis for database structure creation.

Keywords: metrological supervision for industry, legal and industrial metrology, measurement standards, calibration, verification

1. INTRODUCTION

Metrological supervision process in industrial enterprise can be defined as structured, accurate set of actions that are dedicated to ensure the metrological traceability in the legal and industrial metrology. Integrated into the general process management infrastructure of the company it can ensure the quality of the product or service that is provided by the company and increase its competitiveness. Any equipment is only one part of the measurement process. Personnel that provide various tasks and participate in measurement process must know how correctly use each device or equipment and how to analyse and interpret the measurement results [1]. Such system can be implemented by creating database structure for the classification of metrological instruments as well as control and support of metrological supervision process.

To create such system the analysis of measuring instruments inventory is necessary to distinguish recurrent characteristics that are suitable for classification. After these characteristics have been distinguished, criteria lists for the classification model can be prepared that will include all relevant information of the measuring instruments inventory, i.e. measuring instrument error, measurement uncertainty, next calibration date, accuracy class, etc.

Metrological supervision control system is related to the classification system. Supervision control system is dedicated to notify the user about forthcoming events that are necessary to individual measuring instruments (forthcoming maintenance or calibration events). It is also

used to provide the measuring instrument usage history statistics (usage frequency, calibration data (results), measurement uncertainty change over time, repairs, etc.).

For such system creation following work has to be done: identification and optimization of the metrological parameters of the measuring instruments, establishment of criteria for measuring instruments classification into industrial and legal metrology fields, determination of allowed parameter deviation under exploitation, verification and/or calibration conditions. It is the primary work that has to be performed in the company. Then systematic research is needed. It comprises evaluation of interconnection of separate measuring instruments groups by optimizing verification/calibration conditions and calibration parameters of the reference measuring instruments ensuring calibration procedure errors on all levels of the measurement traceability sequence.

Finally development of algorithm to integrate measuring instruments into global metrological infrastructure of the industrial enterprise according to the general progress trends of the national and international metrological systems has to be provided. This algorithm allows optimization of measuring instruments verification and calibration frequency determination process and ensures fluent work of any company.

2. ANALYSIS OF METROLOGICAL SUPERVISION PROCESS

Metrological supervision processes in certain countries must conform to the laws, regulations and decisions of competent and official bodies in the field of legal metrology. However, supervision procedures may differ between countries. Therefore, the structure of metrological supervision has to be in any country and take into account the economic system, the principles of its legal system.

Our research showed that it would be purposeful to divide the process of metrological supervision into separate stages. Simplified algorithm of general process is given in Fig. 1. The actions that are shown in figure 1 are closely linked to other processes and database systems of company. Database (of measuring instruments) has to be complemented, renewed regarding to results of provided verifications and calibrations. If company still does not have

database for supervision process it is recommended to create it. Maintained and ordered database can help every employer to understand needful metrological supervision for each device. Also it allows advanced planning of works and activities (for example some devices have to be calibrated or verified exact date). Statistical analysis has to be performed with the purpose to adjust supervision process to the optimal variant. Consistent review of supervision procedures and their results allows reaching efficient control of all equipment that is in industrial company.

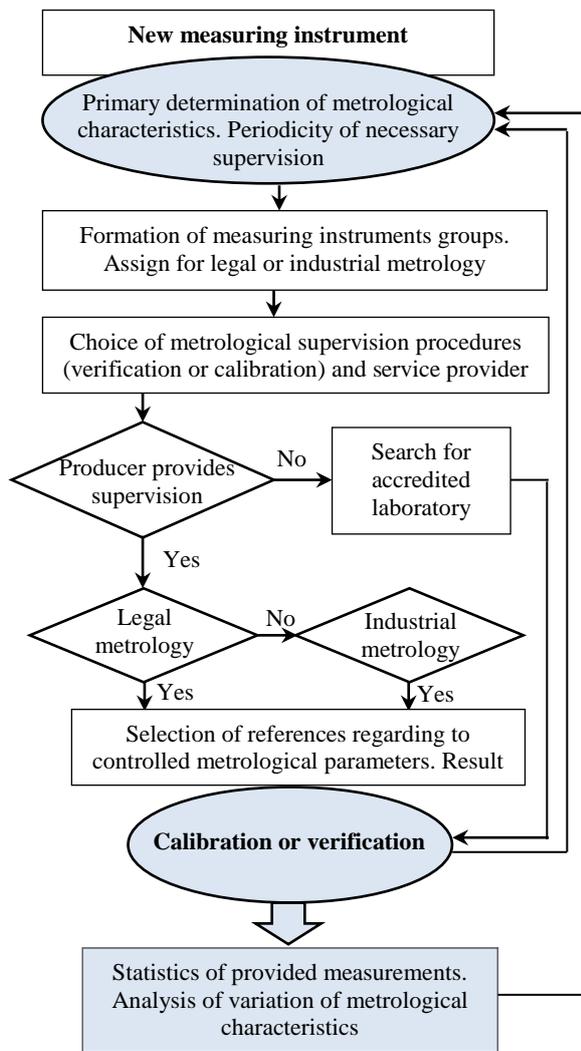


Fig. 1. The metrological supervision process for various industrial enterprises

Performed analysis and received requests showed that many companies confront the problem that they still do not have united system for metrological supervision. Usually they do not have enough knowledge, skills and competence to understand what procedures are needful for their devices and how often they have to be performed. They cannot correctly assign devices to legal or industrial metrology fields. Despite the fact that equipment is new and modern the absence of supervision processes cannot ensure the trueness and reliability of results or quality of produced product.

At first glance this analysis and evaluation can seem very simple. It is not true. The huge companies that have thousands of devices, measures, reference standards really confront serious problem with proper supervision. It is quite important that metrological supervision may also cover requirements relating to safety, EMC, software identification, correct use, marking and etc.

Quality control and quality assurance of provided activities (including manufacturing of any product or just providing various measurements) usually is the main objective [2]. To implement this task it is necessary to have comprehensive plan for whole activity process control.

Industrial enterprises confront the demand for clear and easily understandable algorithms for metrological supervision of their measuring instruments.

3. OPTIMIZATION OF MEASURING INSTRUMENT CHARACTERISTICS

Whole metrological supervision process is related to criteria or regulations that are applied for measuring instruments. Particular measuring instrument is selected depending on measured parameter in technological process as well as reference standards are used depending on controlled parameters of devices that have to be tested or calibrated.

Measuring instruments can be divided into groups by several features:

- Measuring instruments that measure electrical and non-electrical quantities;
- Measuring instruments and reference standards that are used in legal or industrial metrology.

Figure 2 represents controlled parameters for mentioned groups of measuring instruments.

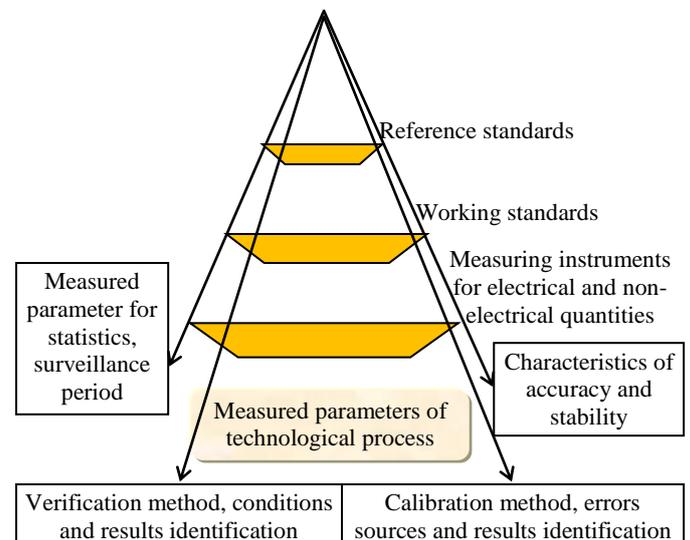


Fig.2. Classification scheme of measuring instrument parameters

Division of instruments to different groups enables to determinate the procedure of metrological supervision, i.e. calibration or verification. Then periodicity of these procedures can be appointed. Scheduled database facilitates

works planning and makes supervision system understandable for everyone.

The measuring system consisting of some devices has to be lot as separate group. Measuring systems especially with remote control or remote data acquisition are used to simplify and fasten nowadays needs. As examples of such systems can be heat or water accounting systems that are installed in private houses or any other complex equipment that can be mounted in enterprises. Usually such systems belong to legal metrology field and their metrological supervision must ensure proper work of whole system from

reading device to data transfer.

4. MODEL OF METROLOGICAL SUPERVISION CONTROL

In accordance with optimized parameters the model of metrological supervision process control is composed. The correlations between performed procedures of metrological supervision (that are described in Fig. 1) are given in algorithm form. The flow diagrams of metrological supervision process will be involved in the communication analysis [3] and are shown in Fig. 3.

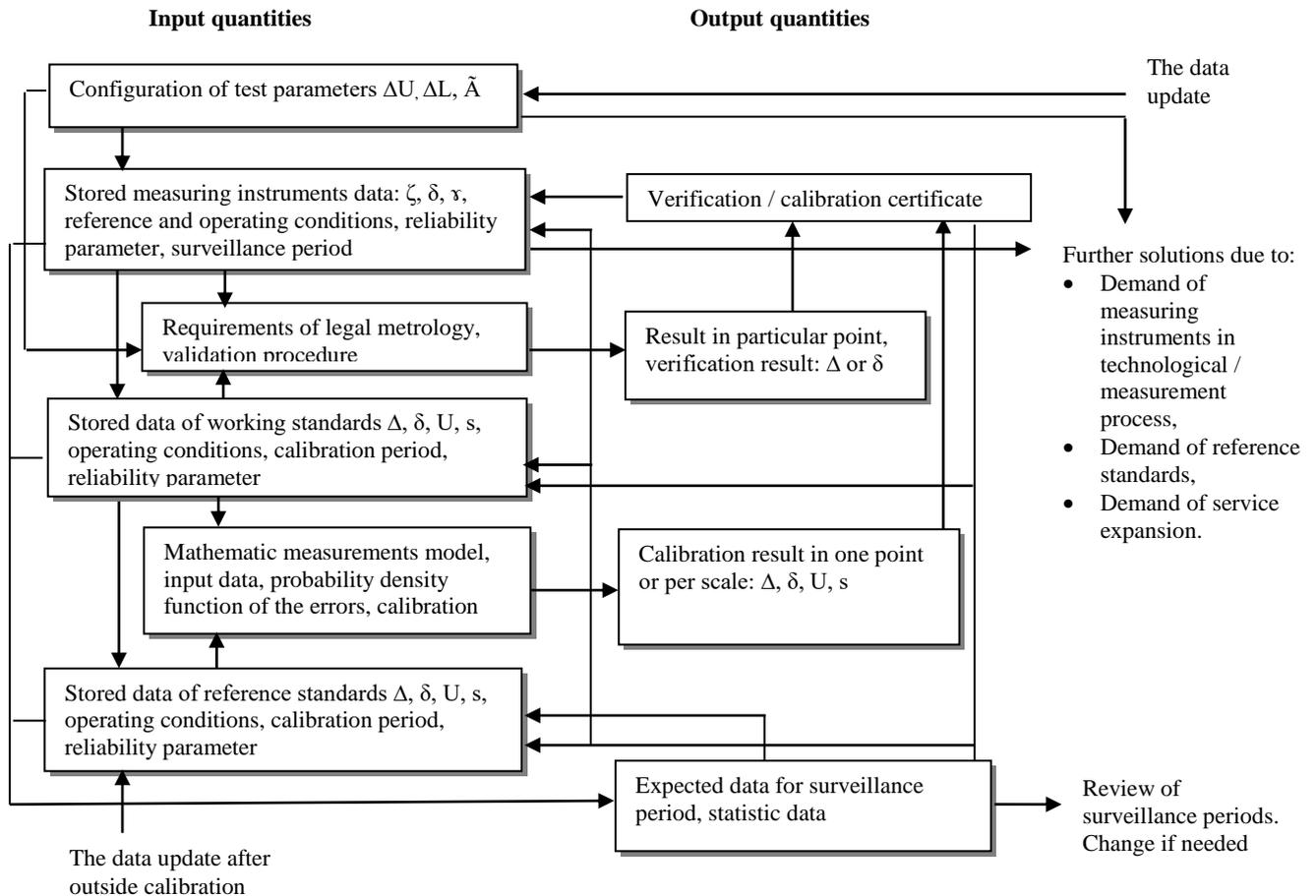


Fig. 3. Input and output quantities involved in the general communication analysis

All above mentioned measurement process conceptions and created general measurement process models: measurement as a comparison, the “output/input black box”, “set-theoretical”, “generalized” models [4] have to be incorporated to final supervision process control structure.

The data and results will be used to understand measurement and measuring instruments supervision process so that this process and future processes may be improved. To update the system invoking new tendencies of science, industry, technologies, IT has to be considered. It has to contribute advantage in control process, to increase conformity with the economics demands.

REFERENCES

- [1] Measurement System Analysis. Reference manual, fourth Edition, 2010.
- [2] N. V. Raghavendra, L. Krishnamurthy. Engineering metrology and measurements. Oxford University Press 2013.
- [3] Transverse Disciplines in Metrology: proceedings of the 13th International Metrology congress, 2007, Lille, France/French College of Metrology. ISTE Ltd, 2009.
- [4] Mari L. P., Handbook of Measuring System Desin. Edited by Sydenham P.H, Thorn R. John Wiley & Sons.Ltd, 2005. Vol.3. article. 104.