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## Importance of education and competence maintenance in metrology field (measurement science)

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**Abstract.** For certain tasks in metrology field trained employers might be necessary to fulfill specific requirements. It is important to pay attention that metrologists are responsible for fluent work of devices that belong to huge variety of wide spectrum of measurements. People who perform measurements (that are related to our safety, security or everyday life) with reliable measuring instruments must be sure for trueness of their results or conclusions. So with the purpose to reach the harmony between the ordinary man and his used means it is very important to ensure competence of specialists that are responsible for mentioned harmony implementation. Usually these specialists have a university degree and perform highly specified tasks in science, industry or laboratories. Their task is quite narrow. For example, type approval of measuring instrument or calibration and verification. Due to the fact that the number of such employers and their tasks is relatively small in the field of legal metrology, this paper focuses on the significance of training and qualification of legal metrology officers.

### Introduction

To ensure the competence and qualification of legal metrology officers who carry out verification, inspection and supervision in the field of legal metrology there is a certain need for a specific training program. International Document OIML D 14 Training and qualification of legal metrology personnel is the legal basis for training and qualification [1].

This document also is the main basis for assurance of national metrological system in Lithuania creating and implementing complex program for qualification and training of metrology officers. The aim of the program is to harmonize competence of metrology officers with the practical appliance. Regarding to measurement areas as use of balances where each gram determines the price, the water or heat meters where the used amount is directly related to our expenses or such sensitive area as medicine the need of qualified and competent metrology personnel is evidence. Also our security involves all possible ways to reduce fraud or corrupt practices.

The review of metrological situation in Lithuania and other Baltic States (especially Latvia) seems to be strange because of the latest actions of the great officers of state lead our countries to destruction of metrological system. Still our country has a certified training system that is provided by Metrology institute. But resent practice showed that Latvia destroyed this system some years ago and now they confront with the difficulties when new personnel do not have primary basis and knowledge of metrology terms, uncertainty evaluation even basic tasks as verification performance.

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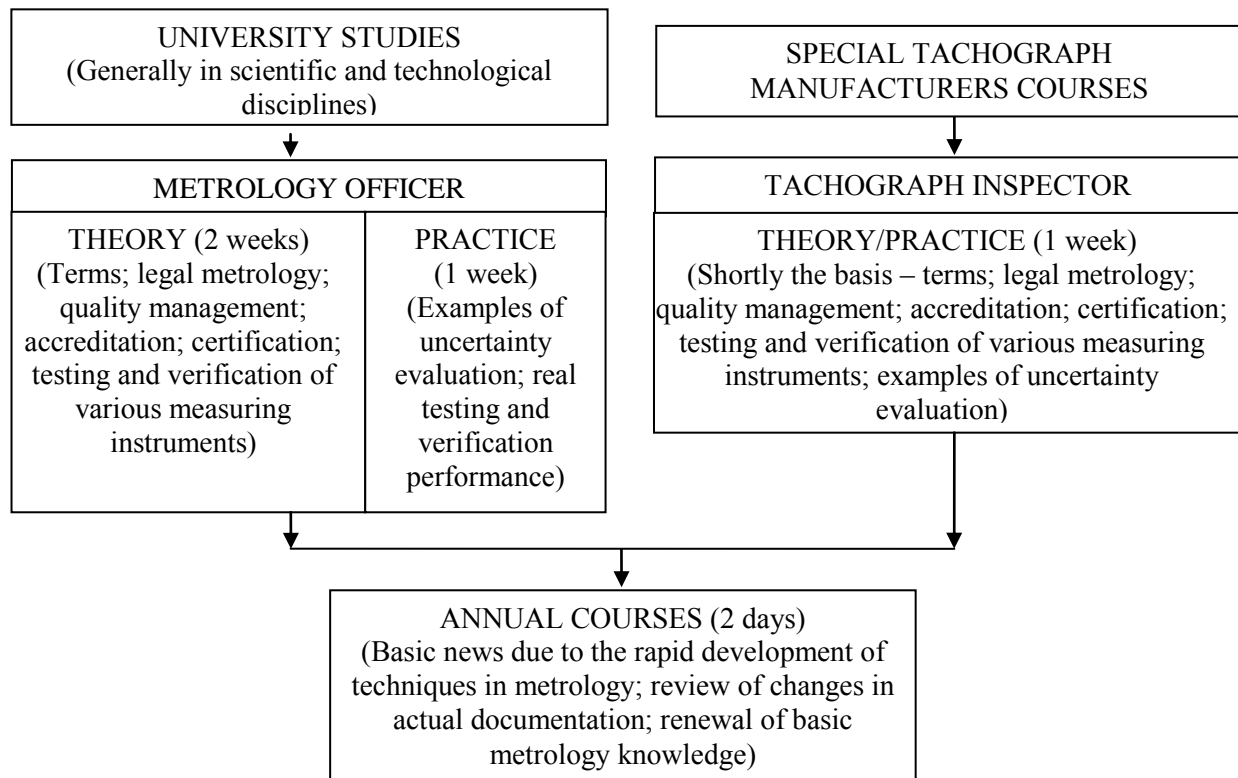
**1. Model of metrology personnel education**

As it was mentioned metrology personnel education is organised by the OIML D14 with adjustment to our country needs. We have 5 programs that allow ensuring fluent work of metrology system:

1. Training courses of metrology inspectors and metrologists (This program is applied to individuals who want to gain the metrologist and/or metrology inspector qualification);
2. Training course for tachograph inspector (Attendees have to be trained by tachograph manufacturers and here they gain qualification of tachograph inspector with metrologist competence and basic knowledge);
3. Refresher course-seminar for metrology personnel – annual courses (This program is applied to continued training of metrologists (and tachograph inspectors);
4. Seminar for metrologists (Here can be gained deeper knowledge of one specific field, for example, mass measurements, metrology in chemical laboratories, advanced metrology, etc.);
5. Reassessment of metrology inspectors and tachograph inspectors (Program is applied to improve the qualification. If inspectors participated in refresher courses annually (for 5 years) then their qualification is improved automatically. Metrology inspectors, who did not participate in such courses or participated partly, have adequate examination.)

Educational program for metrology qualification has changed for some last years. Earlier these courses were divided into 4 specialized fields: non-electrical measurements, electrical measurements, physical-chemical measurements, and radiation measurements. Analysis of needs showed that extensive specialization is much more useful for fast growing and changing technologies century. So now non-electrical and electrical measurements specializations are joined into metrology officer specialization and other various specializations can be improved in specially organised seminar. Also tachograph inspectors training is provided as separate program.

A system of metrology personnel education and qualification development is presented in Figure 1.

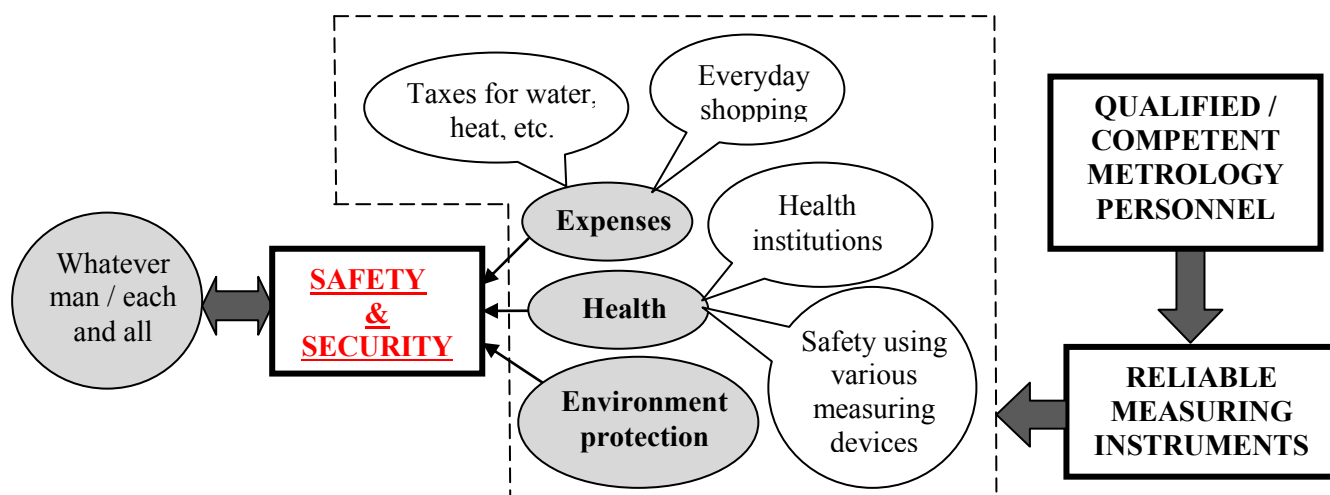


**Figure 1.** Model of metrology personnel education

## 2. The relationship between education and safety and security

Measurements are met in almost all human activities ranging from various production controls, measurements and status evaluation of environmental quality, health and safety assessment, conformity assessment of products to consumer protection and fair trade assurance [3].

Because of metrology science includes control of all above mentioned fields and also units of measurement and their standards, measuring instruments and their field of application, theoretical and practical problems, here appears direct relationship between human safety (security) and qualified / competent personnel that is responsible for the primary step of whole measurements (Fig. 2).



**Figure 2.** The relationship between qualified metrology personnel and human safety / security

Trying to reach better understanding of relationship between qualified metrology personnel and human safety / security it is purposeful to fathom the measurements. What is that? Where they are met? Who perform them? And where is that relation? Firstly, measurements enter into practically all commercial transactions from the trading of goods to the retail sale of goods in the market place. Here legal metrology must ensure that during the each sale the actual amount of every good must be not less or higher than the quantity contracted and paid for. The same rule is applied to prepackaged goods; various facilities (for example, consumed water, heat, time in the internet, time of phone conversations, etc.). Net content (it is not very important the particular object) carried out by the legal metrology protects every of us when we cannot verify the net quantity of contents.

Secondly, the health is especially sensitive field. The measurements here are absolutely different from other metrological areas. The measurement object is a human. Every “measurand” is different. Measurements in this field are variable due to unrepeatability of measurements. So the need of more reliable, comparable and efficient diagnostic and therapeutic methods remains open as the development of new technique for health care. Responsible control on the performed measurements and used measuring instruments in all health institutions is equally important from the consumer protection viewpoint. Now we can talk about medical instruments and about all other measuring instruments that can cause any trouble. For example, in the medicine thermometer or a blood pressure instrument that is not properly verified may lead to wrong diagnosis and incorrect medication [3]. And these are so small side of possible examples.

The field of environmental protection and pollution monitoring is very wide and very close to humanity. Our planet extremely needs of more accurate measurements. For example, measurement of energy consumption helps to better understand and control the use of energy, measurement of various properties of our soils helps to control contamination of used food or ground waters, measurement of pollutants in the atmosphere let us evaluate impact of human activities and etc. New stable and reproducible measurement standards for environmental changes

monitoring have to be created. Just perfect knowledge, competence and understanding can help in research of new innovative systems and technologies that could help stop or prevent negative environmental impacts. Also additional measurements must be made in many areas in order to accurately and correctly determine the sources of these changes.

### 3. Metrology education and situation in Europe

Metrology is quite unusual profession but it is met very wide: from measurement systems or instruments design to calibration works, scientific research, and everyday life. The new products and technologies, their legislation depends on metrology [4]. Considering the large variety of people in this field we can realise how broad the metrology matter is. Metrology comprises concepts from physics, chemistry, biology and medicine, mathematics, all kinds of engineering. Person who needs to gain a metrology speciality should have a strong grounding in physics or other technological science. During metrology courses the specialized knowledge in metrology is gained but it is preferred that the learning person should have the most common knowledge in mechanical and electrical measurements, also have understanding about the main measurands, for example time, mass, temperature, pressure and etc. In many cases the understanding of more than one field is needed. With an increasing demand for higher accuracy, traceable measurements play a crucial role in almost every aspects of modern life. The measured ranges become wider from very small quantities to extra-large and this tendency has growing character in year's viewpoint. And relevant qualification plays very important role for fast changing and growing measurement world (Fig. 3).

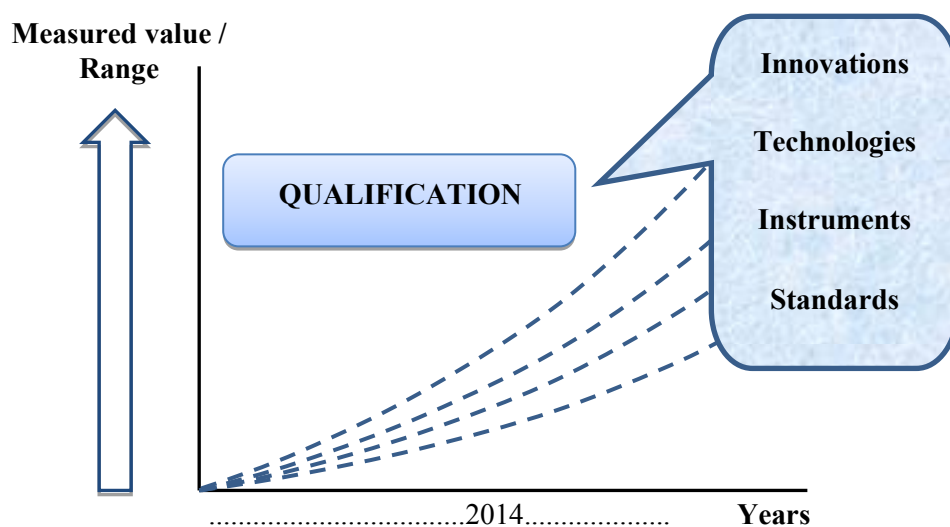


Figure 3. Qualification demand

Good metrology system and qualified specialists can help in increasing productivity and efficiency, improving repeatability by minimizing human errors, increasing customer satisfaction and saving money applying new or suitable technologies for various tasks. Many Europe and also World countries with established metrology system have metrology training centres, specialized educational institutions and formal metrology education at technical schools and/or university level [4]. Mostly metrology education is accomplished through short special courses where theoretical and practical skills are gained.

### 4. Conclusions

A key challenge is the need to ensure human safety and security. Continuous and sustainable growth whilst reducing negative impacts in many fields leads to more qualitative understanding of importance of education and competence maintenance of responsible personnel.

The nature of the challenges faced in protecting the environment and in developing new sustainable technologies dictates a multi-disciplinary approach that will drive the requirement for research that brings together different disciplines within measurement science. One of the most important tasks is to pay more attention to expedient and continuous training.

Metrology education and competence maintenance following innovations, standardization should reach organizations, industry and be spread between metrology institutes inside and outside Europe.

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