

## **A Modern Scheme for Education, Training and Certification of Metrology and Measurement Technique Personnel**

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### ***Abstract:***

*This contribution describes the importance of certification of personnel working both in the fields of metrology and quality assurance on the one side in industry and economics in general and on the other side in any other kind of organisations both in the service and in the public domain. In Europe exists a harmonised scheme for the international registration and certification of quality personnel that is fully recognised between more than thirty countries throughout whole Europe and similar educational activities have already been proposed recently for education in metrology and to train metrology personnel and experts in the field of metrology.*

*This harmonised scheme can be taken as example to organise education in the field of metrology. The Department for Interchangeable Manufacturing and Industrial Metrology of Vienna University of Technology (TU-Wien) is one of the only two organisations in Austria being accredited for the registration and certification of quality personnel. This is insofar important for a University department as this opens new possibilities for educational processes at Universities.*

*Keywords: metrology, quality management, quality personnel, accreditation, certification, harmonised scheme, coordinate metrology*

### **1 Introductory Remarks**

In most European organisations, the battle has been won to have quality recognised as a fundamental management discipline [1, 2]. The focus has now shifted to the experience, training, qualifications and recognition of quality personnel, but also of certified personnel in other areas whereas metrology is of special importance in the industrialised countries of Europe and specific areas of metrology as there is especially coordinate metrology. Merely having people with specific responsibilities for their working capabilities does not guarantee that you have quality personnel. A growing part of the industry is looking to the EOQ's harmonised scheme for the assurance that quality practitioners are fit for their purpose whereas EOQ stands for European Organisation for Quality. This contribution gives the general background and outlines for other areas as there are metrology or automation technique where there exist similar general requirements.

### **2 Description of the European System for Quality Personnel**

At present quality is well established as a fundamental issue of the management of different types of organisations both in economics and in the public domain [3, 4]. As all types of organisations plan for today and tomorrow, they have an urgent need for well-trained and experienced quality personnel in all aspects of the discipline. In Europe, professionals are

now more mobile than ever and, with moves towards greater harmonisation of business practices within the European Union and beyond, there is a real demand for a European system of quality training and qualifications but also in other areas as metrology.

Such a system exists in the form of the "EOQ Harmonised Scheme" for the qualification, certification and registration of quality personnel [5]. The European Organisation for Quality EOQ established the scheme as part of its mission to strengthen Europe's economic system by promoting improvement in all aspects of quality - from developments in quality systems management through to the use of quality as a competitive market force by anticipating customer needs and creating customer confidence. As the co-ordinating body and catalyst for its more than thirty national full member organisations (FMO's), the EOQ has a unique outlook on the contribution that quality makes to organisations of all types, in all sectors, right across Europe.

The "EOQ Harmonised Scheme for the Qualification and Registration of Quality Personnel" was introduced in 1994. It uses the training and qualification schemes that already exist in most of the EOQ's member countries and strengthens them by harmonising the relevant procedures. But the EOQ scheme does not prescribe how the training of quality personnel should be conducted. The EOQ's goal is to achieve mutual recognition of qualifications within the scheme and, hence, the registration and certification of quality personnel.

### **3 Different Categories of Quality Personnel According to the European Harmonised Scheme**

Several categories of quality personnel are identified by the EOQ scheme:

- An **EOQ quality professional** is, for example, a quality engineer with responsibilities for devising and applying quality techniques.
- An **EOQ quality systems manager** holds the responsibility for the creation and implementation of a quality system within a company or organisation.
- An **EOQ quality auditor** is a person qualified to conduct external (third party) audits.
- An **EOQ TQM assessor** is qualified to perform self-assessments (internal assessments) and/or third party assessments (external assessments). Such a person is also eligible to take part in the assessment process for the national quality awards. The assessments are performed according to Business Excellence models, European or equivalents.
- An **EOQ TQM leader** is qualified to lead, coach and support in a professional manner management and staff of an organisation in the management of change towards TQM, in accordance with TQM/Excellence models, either European or equivalents.

Besides these categories there exist also personnel that is engaged in the fields of environmental management and health and security management:

- An **EOQ environmental systems manager** holds the responsibility for the creation and implementation and further development of an Environmental Management System (EMS).
- An **EOQ environmental auditor** is qualified to perform environmental audits (2nd and 3rd party audits).
- An **EOQ health and safety systems manager** holds the responsibility for the creation and implementation of a Health And Safety Management System (HSMS). An EOQ health and safety auditor is qualified to perform health and safety system audits (2nd and 3rd party audits).

The EOQ scheme has been welcomed as being genuinely European and has been commended for its openness, transparency and credibility in the eyes of a wide range of users.

#### **4 The Structure of the European Scheme for Quality Personnel**

To set up its harmonised scheme, EOQ first agreed with its participating FMOs on the requirements needed to achieve international conformity. Harmonised EOQ rules and procedures were then established for both the qualification and the registration of quality personnel. These rules and procedures are based on EN 45013 General Criteria for Bodies Operating Certification of Personnel and the ISO 10011 series standards. The FMOs are the EOQ's national agents for the scheme. For an FMO to be recognised as an agent, it must either prove that it is accredited as a certification body by its national accreditation authority or undergo a rigorous peer evaluation by auditors appointed by the EOQ for that purpose. All recognised FMOs are also audited periodically by EOQ. Participating FMOs must satisfy EOQ at all times that national procedures meet the requirements of the harmonised scheme. FMOs are also obliged to recognise the training and certification provided by other bodies in their countries, so long as they meet the EOQ scheme's rules and requirements. Each FMO offers up successful candidates (trained by themselves or by other qualifying and registered national bodies) in the five categories to the EOQ General Secretariat, which is the central point for registration and the issuing of certificates. Each registration and certificate carries an exclusive identification number, which ensures that each record is dedicated and can easily be traced and updated as necessary.

##### **4.1 EOQ Quality Professionals:**

Candidates for the EOQ quality professional category should hold a university degree or equivalent relevant to their fields of employment. To cope with a wide variety of national education systems, the definition of equivalence to a university degree is left to the discretion of the FMOs participating in the scheme. Before qualifying as an EOQ quality professional, the candidate should have gained appropriate practical workplace training and experience over a minimum period of one year. In addition, they should have at least one year's practical experience in quality assurance. Certain personal characteristics are closely associated with the designation of EOQ quality professional. Individuals should be open-minded, honest, loyal, skilled and be ready to accept and to learn new techniques. Ability to work in teams and cost-consciousness are additional characteristics.

Capabilities after the relevant training courses EOQ quality professionals must be competent in all quality assurance techniques. These competencies cover the understanding and practical application of disciplines throughout the life-cycle of product or service delivery.

##### **4.2 EOQ Quality System Managers:**

Candidates for the EOQ quality systems manager category should hold a university degree or equivalent, relevant to their fields of employment. Again, the definition of equivalence is a matter for the agent FMO. Before qualifying as a quality systems manager, the candidates should have accumulated appropriate practical workplace training and experience over a minimum period of two years. In addition they should have at least two years' practical experience in quality assurance, part of which should be in quality systems management.

EOQ quality systems managers should be open-minded, quality-minded, honest, loyal, skilled and ready to accept and to learn new techniques. They should have managerial abilities, demonstrate the ability to work in teams and should be cost-conscious. Capabilities after the

relevant training courses EOQ quality systems managers must be competent in all quality management techniques.

EOQ quality systems managers must have the ability to install quality systems that meet the requirements of any size of company and to act as the management representative.

#### 4.3 EOQ Quality Auditors:

The candidates for the EOQ quality auditor category must have met the qualification requirements of EOQ quality professionals or EOQ quality systems managers. In addition they must have a minimum of four years' appropriate, fulltime, practical workplace experience, at least two years of which should have been in quality assurance/management activities. Prior to qualification, the candidates must undergo training in the conduct and management of audits.

After the relevant training courses EOQ quality auditors must be competent in all the adequate quality related techniques required for quality professionals and for quality systems managers. Before recognising a candidate as an EOQ quality auditor, EOQ must be convinced that this person is able to carry out a first-class audit.

#### 4.4 Other Categories of Personnel:

As already mentioned in chapter 3 there do exist also other categories of personnel whereas the specific descriptions of competences and requirements can be found in the reference [5].

### 5 Establishment of a Certification Organisation

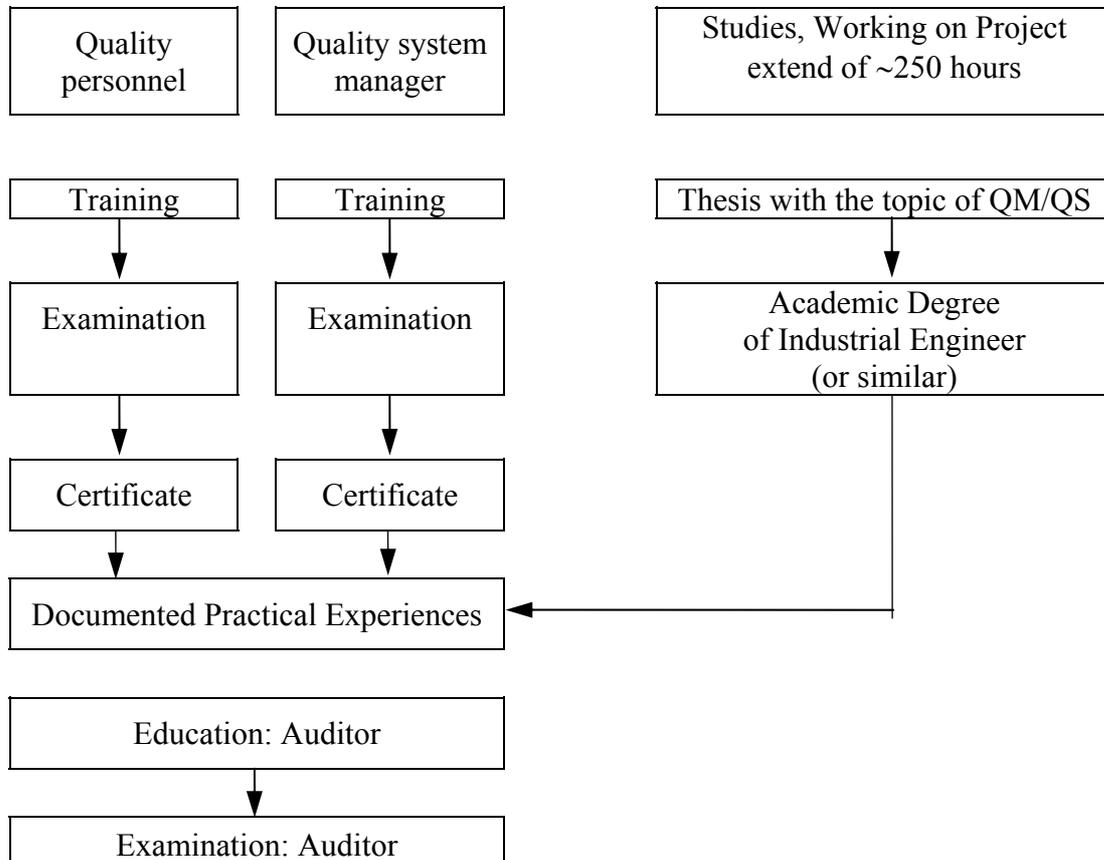
The Department for Interchangeable Manufacturing and Industrial Metrology (Abteilung Austauschbau und Messtechnik - AuM) of the Institute of Production Engineering at Vienna University of Technology (TU-Wien) started its work for establishing itself as a certification body for quality personnel in 1996 after having been granted with an EN/ISO 9001 certificate for quality management of educational processes by a well known international certification corporation in July 1995 being world wide one of the first University Institutes having such a certificate [4]. The building up of the specific quality management system with all necessary documents was a very hard task and it took the Department more than two years to fulfil that task. Part of the system is a specific educational scheme that takes into consideration that also young academics especially in the engineering field will be candidates for excellently trained quality personnel (see Fig. 1).

### 6 The Proposed Scheme for Education, Training and Certification of Metrologists

In analogy to the harmonized scheme for quality personnel a proposal was made for education, training and certification of metrology personnel and persons working in specific areas of metrology as there are production metrology or coordinate metrology [7, 8].

The scheme shown in Fig. 2 is valid for education of experts and leaders in metrology and it is in conformance with Fig. 1 considering the structure of stages and also most of possible assumptions for acquiring the different categories of quality personnel as described in chapter 3 following the adequate European system for quality personnel. There are parallel possibilities for obtaining the common stage of documented practical experience. One way is through studies and thesis on related topics, the other way is through special training and obtaining of the certificate.

The highest level or position that may be obtained within the proposed scheme is the metrology expert and leader. The experts and leaders in metrology lead, coach and support in a professional manner the metrology staff of an organisation or the complete staff of an independent or states owned metrology laboratory.



**Figure 1.** Scheme for Training of Certified Quality Personnel

## 7 Personnel working in coordinate metrology as typical example for metrology personnel

The application field of coordinate metrology is continuously increasing, due to the universality and flexibility of coordinate measuring machines (CMM). Their varying applications require a high degree of basic and action knowledge from the CMM operator and measurement planner, in order to achieve measurement results with the smallest possible measurement uncertainty. Measurement errors in coordinate metrology are caused by the operator, environment, workpiece and measuring machine.

Only very little information is available on the influences of the operator, although this can be the cause of the greatest deviations in results. To achieve measurement results with small uncertainties that are reliable and largely operator-independent, it is necessary to place emphasis on the operator's education. In addition to skills for handling of instruments and software the operator has to possess a well-founded knowledge of instrument technology and the evaluation process, closely connected with extensive knowledge of physics and mathematics, metrological experience, and thorough knowledge of engineering design standards. This can only be guaranteed by a comprehensive and profound training.

7.1 The competence of personnel:

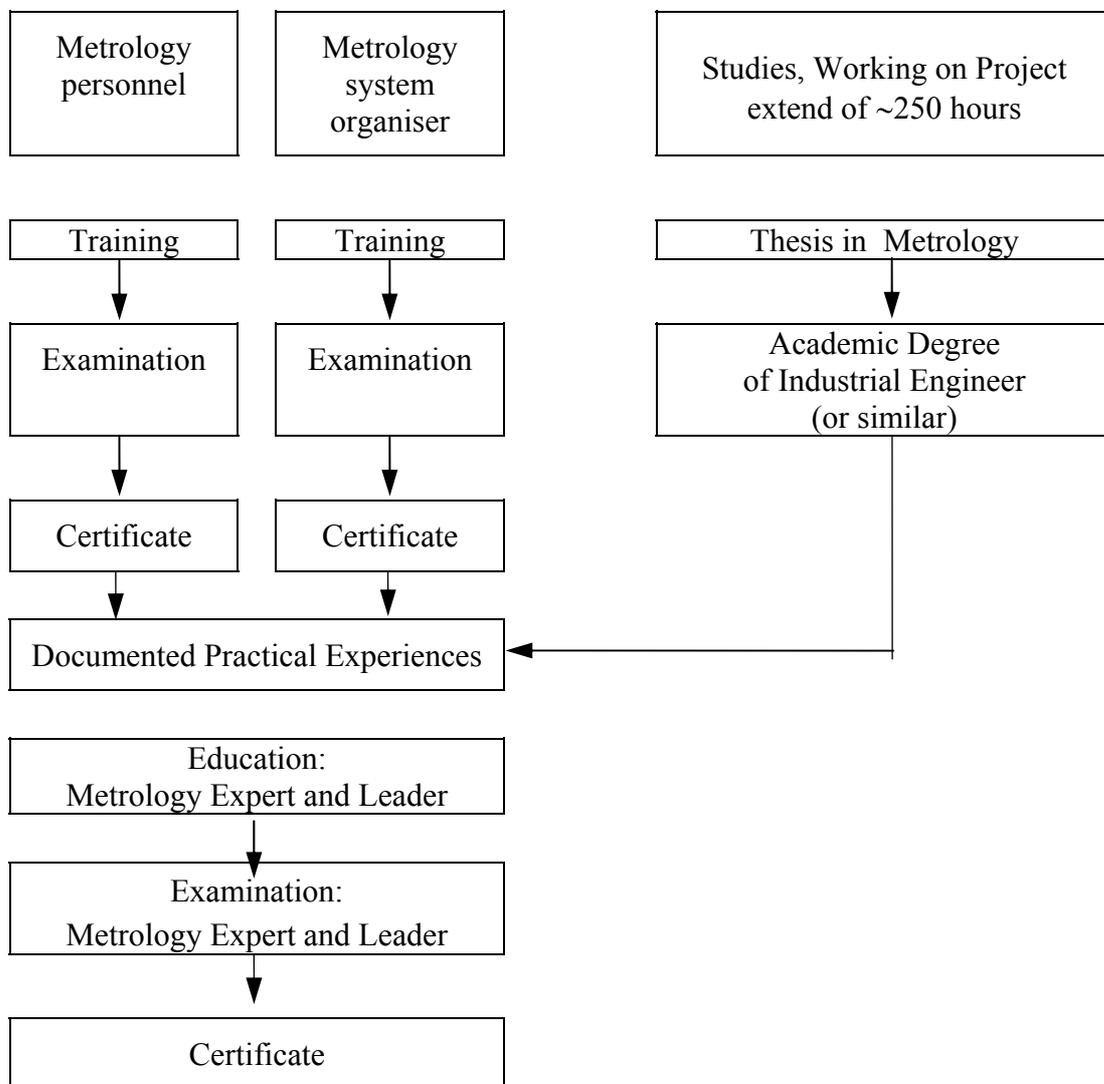
Under the competence of a person or personnel in general it can be understood a person's demonstrated knowledge, skills and attributes and the demonstrated ability to apply knowledge and skills; by means of the results of standardised examinations the competence and its extent is demonstrated and stated in a certificate respectively [7].

In coordinate metrology the term competence level expresses that according to common CMM practice knowledge or qualification of different depth and theoretical background is needed when carrying out measurement tasks on or with a CMM.

The described system distinguishes between the three levels

- CMM-user,
- CMM-operator and
- CMM-expert

of user profiles, which are common with CMM practice [7, 8]



**Figure 2.** Scheme for Training of Certified Metrology Personnel

## 7.2 Definition and short description of the three different competence levels of CMM personnel:

CMM-user is a person who is able to carry out measurements on or with a CMM on the basis of already existing measurement programs. This is the lowest competence level of metrology personnel in the area of coordinate metrology.

CMM-operator is a person who is able to write simple CNC measurement programs and modify existing CNC programs, monitor the CMM and equipment and carry out independently measurements with CMMs and evaluation of measurement results respectively.

CMM-expert is a person who is able to writing test plans, writing and optimising CNC programs for all measurement tasks, supervising measurements and user qualifications, evaluation of measurement uncertainty and implementing methods of quality management.

## 8 Concluding Remarks

The certification of personnel working in the field of quality assurance and quality management is very important in industry and economics as well as in the public domain. In Europe exists a harmonised scheme for the international registration and certification of quality personnel that is fully recognised throughout whole Europe.

The Department for Interchangeable Manufacturing and Industrial Metrology of TU-Wien has been successful in being accredited for the registration and certification of quality personnel according to that scheme. This is also important for a University as whole as this opens new possibilities for educational processes at Universities.

Concerning the building of quality personnel within the automation and/or metrology the authors of this contribution have followed the general scheme of building the quality personnel (an example is shown in Fig. 1), proposed by the European Organisation for Quality.

In analogy to the European harmonized scheme for quality personnel the basics of a proposal is described for education, training and certification of metrologists and persons working in specific areas within metrology as there is coordinate metrology whereas the appropriate competences and requirements are described in draft national and international standards being already in the state of finalisation [7, 8].

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