Chair Quality Management and Manufacturing Metrology
University Erlangen-Nuremberg

Research project "European Training for Coordinate Metrology"

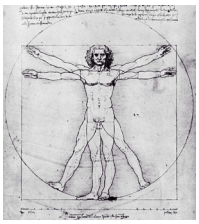
Funded by the European Commission, Leonardo da Vinci-Programme

Abstract

Coordinate metrology currently plays a crucial role within the quality assurance. Therefore, operators must possess a high level of competencies for executing measurement tasks with a coordinate measuring machine. Since a vocational education is missing, the operator has to obtain this knowledge in training lessons. Currently, training is mainly offered by machine manufacturers. In these lessons, only machine-dependent knowledge is focused, metrological competencies are usually unconsidered.

There are occasional activities to eliminate this absence by offering profound and independent training in coordinate metrology. The contents of these training offers are not homogenous and thus their degrees are not comparable. Within the framework of the Leonardo da Vinci-Programme of the European Commission, which predominantly promotes the cooperation of education actors in Europe, the research project "European training for coordinate metrology" pursues the goal of synchronizing these activities European-wide and to raise them to a common, high-quality standard.

Background



A request of the European Union is to promote the cooperation between the member states and all actors are involved in vocational education across national borders. 1995 the European Commission has therefore launched the programme LEONARDO DA VINCI that is currently in the second phase. The programme has three main aims:

- Improvement of skills and competencies,
- Improvement of accessibility and quality of vocational education and of lifelong acquisition of skills and competencies,
- Promotion and encouragement of the contribution of vocational education to the innovation process.

Initial situation

The permanently increasing application fields for coordinate metrology are due to the universality and flexibility of coordinate measuring machines (CMM). Their varied 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 deviations 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 deviations 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 machines and software the operator has to possess a well-founded knowledge about machine technology and the evaluation process coupled 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.

As yet, training is affected in courses provided by the coordinate machine manufacturers, where the focus is only on machine and software specific details. Impartment

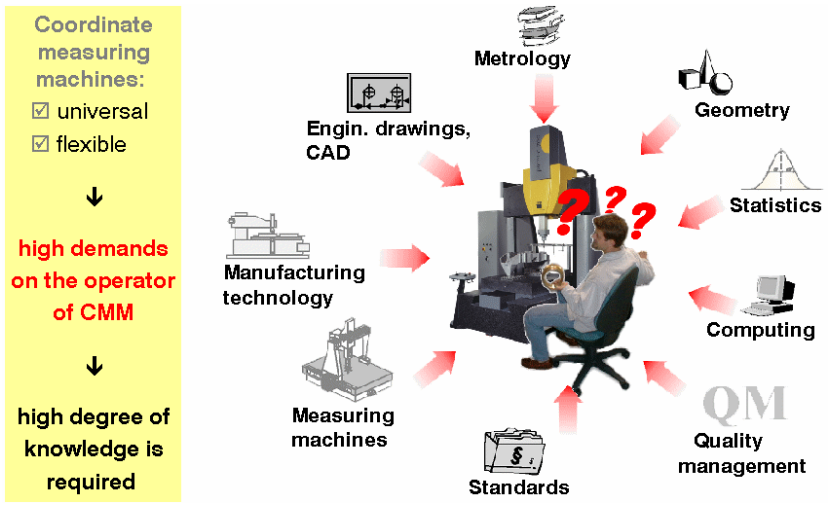


Fig. 1: Required knowledge of operators of coordinate measuring machines

of metrological competencies is unconsidered in these courses.

With the completed research project *„Ausbildungskonzept Koordinatenmesstechnik“* the Chair QFM has dealt with these problems in collaboration with a project companying committee of industry representatives. The team has developed a German training concept for coordinate metrology.

In Germany, training concerning this concept is promoted by the association „AUKOM – Ausbildungskonzept Koordinatenmesstechnik e.V.“. The association has been founded by the industry representatives, which were members of the project companying committee. There are several activities in Europe comparable to AUKOM, which support the education in coordinate metrology, such as in Great Britain and in Italy. However, all these activities exist separately and independently, there is no Europe-wide homogeneous, coordinated action und thus no comparable degrees.

Training concept AUKOM

The research project AUKOM was sponsored by the AiF member organization “Federation for Quality Research and Science” (FQS). An industrial working team consisting of 8 partners from the industry and research institutes has promoted project progress.

Primary objective of the project was providing a comprehensive training concept for operators of CMM:

- with well-founded and practically proven procedures
- with machine independent basics for analysis of measurement tasks, for planning and execution of measurements as well as for evaluation of measurement results
- with interfaces to manufacturer-specific training on measuring machines and software
- with comparable final exams and generally acknowledged certificates

Starting from the deficit that German-wide a homogeneous and comparable training in this field did not existed at this time, the essential knowledge for professional execution of measurements with a CMM has been evaluated and summarized as training contents. These contents have been afterwards classified into three training levels, level 1: CMM-User, level 2: CMM-Operator and level 3: CMM-Expert, on the basis of varying working profiles of CMM operators have been analyzed and with this associated divergent essential standard of knowledge.

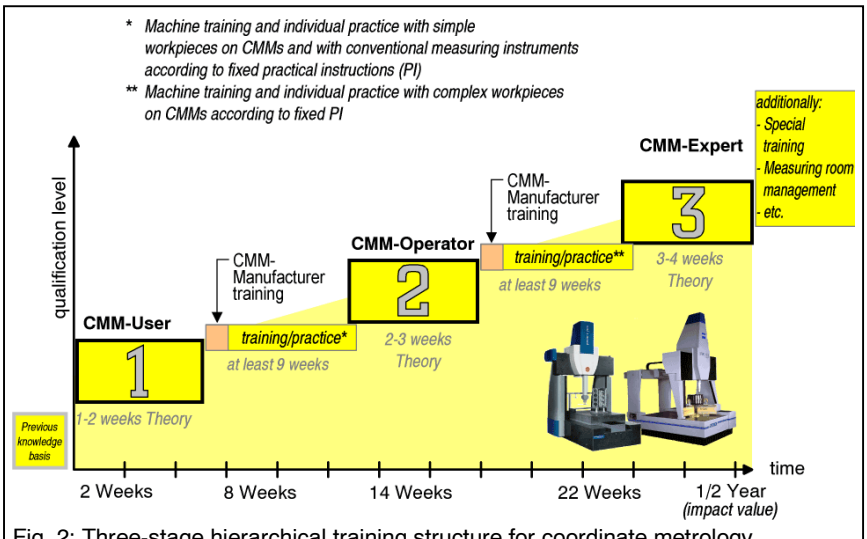


Fig. 2: Three-stage hierarchical training structure for coordinate metrology

The research project was completed at end of the year 2001 after duration of 3 years. Since then the association AUKOM e.V. pays attention to the realization and further development of the training concept. Thereby the association solely takes on professional responsibility for training sessions and leaves the execution of the training to coaches, which are acknowledged by the association.

Aims

Primary objective of the project EUKOM submitted within the framework of LEONARDO DA VINCI pilot projects is the establishment of a comprehensive European training concept in coordinate metrology that fulfils the aspect of the lifelong learning. This objective includes the following partial intentions:

- Definition of an European-wide comparable and high-class qualitative educational level in coordinate metrology
- Preparation of European-wide homogeneous training materials
- Equalization of metrologists who don’t have access to training courses by a European-wide e-Learning offer
- Foundation of a European association, which promotes education in coordinate metrology European-wide

Within the project, an innovative learning arrangement for coordinate metrology will be developed taking the realization of new learning strategies into account. This arrangement will enable a European-wide homogeneous and comparable, high-quality training of

machine operators as well as of lateral hires in coordinate metrology, which finally contributes to a European-wide acknowledgement of acquired skills by issuing a certificate.

Strategy

The project will be conducted in co-operation of 7 European project partners. The curriculum of the training concept, the didactics to be used as well as the form of presentation will be defined together. The work programme contains the following work packages:

- Project- and quality management contains all activities concerning coordination and communication between the project partners. The Chair QFM is contractor and project coordinator.
- Requests of the target group on training in coordinate metrology regarding methodology and content will be determined by means of a European-wide user needs analysis.
- Based on the results of the user needs analysis and the experiences of the project AUKOM the curriculum of the European training concept will be defined. Following, the methodology of the learning arrangement will be determined in consideration of innovative learning theories and learning forms.
- After the analysis of boundary conditions for a training concept and compilation of objectives in the last work packages, the European training concept will be defined.
- For a subsequent evaluation of the developed concept representative training materials will be realized. Thereby documents for face-to-face lessons will be elaborated as well as multimedia learning material will be implemented into an e-Learning platform.
- In closed relationship with the previous work packages the evaluation of the training concept will be carried out. The formative evaluation allows testing and improving the training concept during the development process. The summative evaluation starts when the development of the concept and representative training material is completed. The evaluation of the project progress and of the results will be

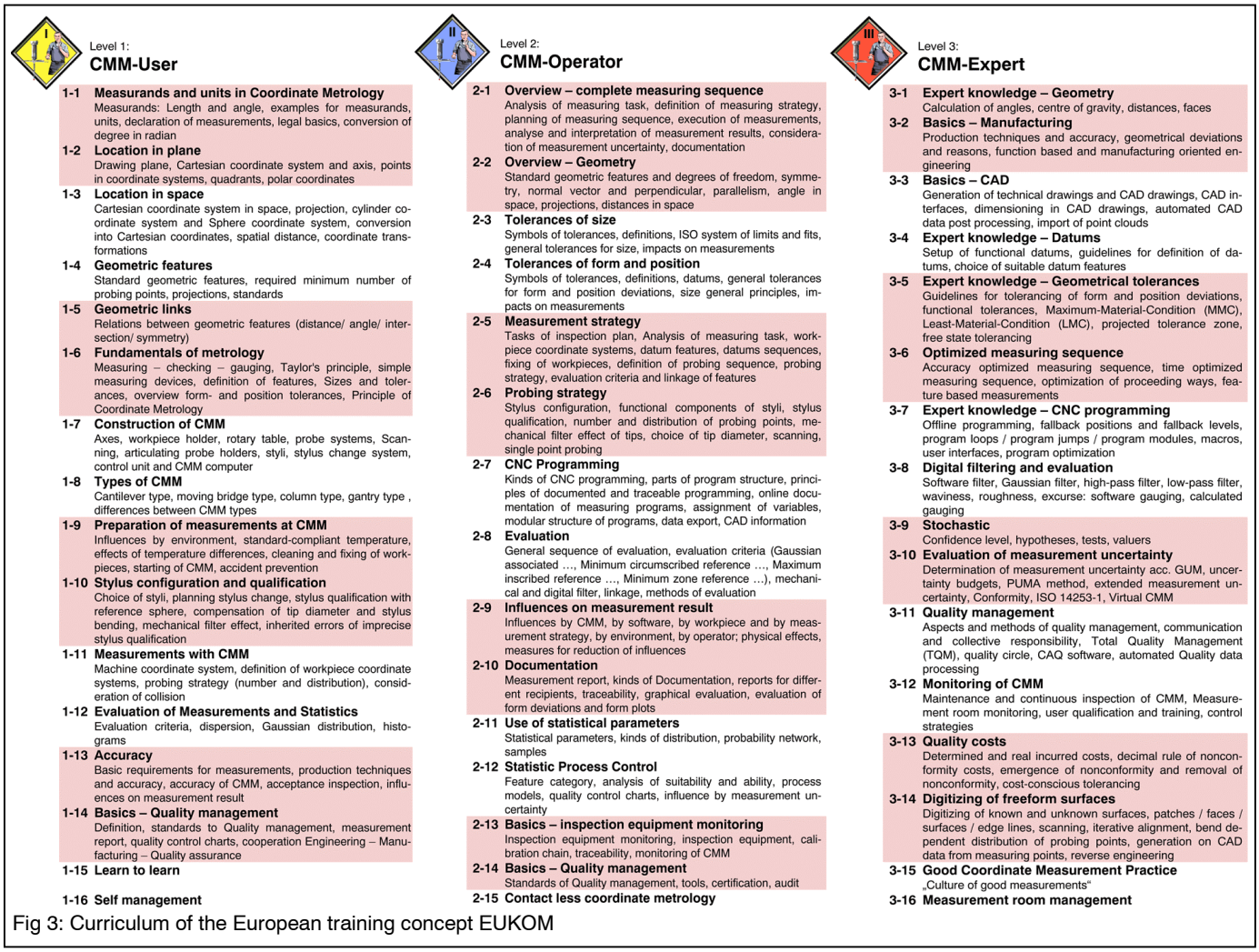


Fig 3: Curriculum of the European training concept EUKOM

utilized with an evaluation tool especially developed for that purpose, which is based on the EFQM model for an assessment of Business Excellence.

- The project results will be published continuously at international conferences, on a current project webpage as well as through articles in international professional journals.
- According to existing associations, which nationally promote education in coordinate metrology, an umbrella organization will be founded, which performs this task in Europe. The foundation preparations are part of final planning for an ongoing use of the project results.

Project progress

The present state of the project activities is:

- The European-wide user needs analysis through interviews of the target group members has been finished.
- Based on the training concept AUKOM the Curriculum has been determined.
- As methodology of the learning arrangement a combination of face-to-face session and e-Learning has been defined.
- Ilias has been selected as e-Learning platform and has been configured. Platform handling has been trained in a workshop.
- Learning aims, contents and didactics are presently defined by the project partners and will be elaborated as training documents and multimedia training materials subsequently.

Project partners

Prof. Dr. Techn. P. H. Osanna
Vienna University of Technology, Department for Interchangeable Manufacturing and Industrial Metrology, Vienna, Austria
http://aum.ift.tuwien.ac.at

Dr.-Phil. Walter F. Kugemann
University Erlangen-Nuremberg, FIM-Psychology, Institute Psychology I, Erlangen, Germany
http://www.fim.uni-erlangen.de

BSc Liam Blunt, Ph.D.
University of Huddersfield, Ultra-Precision Engineering Centre, School of Computing & Engineering, Huddersfield, Great Britain
http://scom.hud.ac.uk

Msc. Marius Bulgaru, Ph.D.
Technical University of Cluj-Napoca, Centrul Regional De Metrologie Industriala Cluj, Cluj-Napoca, Romania
http://www.cermi.utcluj.ro

Dr. Eng. W. Jakubiec
University of Bielsko-Biała, Dept. of Manufacturing Technology and Automation, Bielsko-Biała, Poland
http://www.ktmia.pb.bielsko.pl

Prof. Dr.-Ing. C. P. Keferstein
Interstate University of Applied Sciences of Technology Buchs, Institute Quality Technology, Buchs, Switzerland
http://www.ntb.ch

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Project data

Coordinator:

Prof. Dr.-Ing. A. Weckenmann
University Erlangen-Nuremberg, Chair Quality Management and Manufacturing Metrology, Erlangen, Germany
http://www.qfm.uni-erlangen.de

Responsible:
Dipl.-Ing. (FH) Sebastian Beetz

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Bildung und Kultur
Leonardo da Vinci
Pilotprojekte

University Erlangen-Nuremberg
Chair Quality Management and Manufacturing Metrology
Prof. Dr.-Ing. Dr.h.c. Albert Weckenmann

Naegelsbachstraße 25 · 91052 Erlangen
Telefon: +49 - 9131 - 85 26521 · Telefax +49 - 9131 - 85 26524
E-Mail: qfm@qfm.uni-erlangen.de · Internet http://www.qfm.uni-erlangen.de

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