

DYNAMIC VISION TRAINING MODULE FOR i-LEARNING IN INDUSTRIAL APPLICATIONS

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1. INTRODUCTION

The development of innovative Vision Training Modules based on i-learning systems has become an urgent necessity in present-day industrial metrology. Manufacturers of precision tools increasingly demand that measuring systems can be integrated into their existing manufacturing lines. The term "i-learning" is understood to mean interactive learning or individual learning, and defined as a flexible, electronic mode of learning. The concept using the Vision Training Modules described in this paper will soon be employed to train operators of multisensor coordinate measuring machines in the measurement of precision tools (e.g., drills, hob cutters) as part of the process control loop.

Also if integrated into a process cell, measuring systems must meet the requirement to deliver comparable and repeatable measurement results with small uncertainties. Users operating optical precision measuring equipment in a process cell differ with regard to their knowledge in metrology, design, quality management, etc. In this complex environment, continuous quality improvements and a reduction in quality costs can only be achieved by training modules targeted at different user levels and subjects.

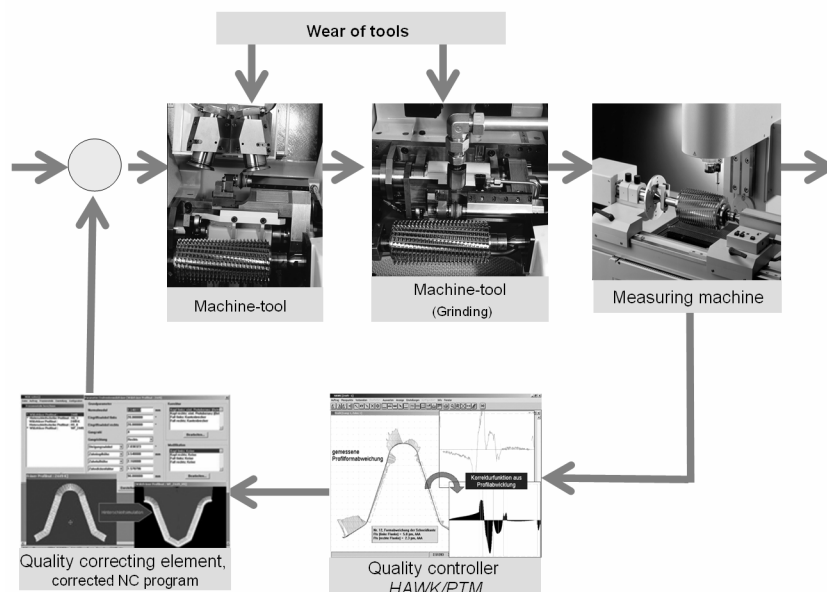


Fig. 1. Process control loop *Machining of hob cutters*

2. STATE OF THE ART IN TRAINING AND DOCUMENTATION

2.1 Modularity of coordinate measuring machines

The demand that measuring equipment can be integrated into a manufacturing quality control loop confronts the manufacturers of coordinate measuring machines with requirements not only regarding the measurement technology but also with regard to ergonomics (e.g., ease of operation) and information technology (e.g., data networking). To reliably measure all quality characteristics specified, a diversity of sensor systems (e.g., optical and contact sensors) have to be employed.

Multisensor coordinate measuring machines, in widespread use today, are of modular design, which means that their hardware and software modules can be configured into variable setups. For example, a hardware module such as an optical measuring head, equipped with a zoom lens or interchangeable fixed-power lenses, can be used on different machines such as UNI-VIS, ACCURE or TAURUS (Mahr-OKM). The modularity of the systems both enables and requires that operating instructions are modular as well, i.e. taught in the form of dynamic training modules.

2.2 Documentation and training in coordinate measuring

Training materials currently used in coordinate measurement differ in their structure from manufacturer to manufacturer. As a rule, the users of the measuring systems are assumed to have a high level of prior knowledge in coordinate measurement. Training is imparted by way of text-based instructions written in different Office formats, which cannot be combined; these texts, therefore, lack a dynamic quality.

The *AUKOM e.V.* association was founded with the aim of supporting user-oriented and documentable training in coordinate measurement that satisfies current needs irrespective of equipment manufacturers. Its members are well-known manufacturers and users of coordinate measuring machines.

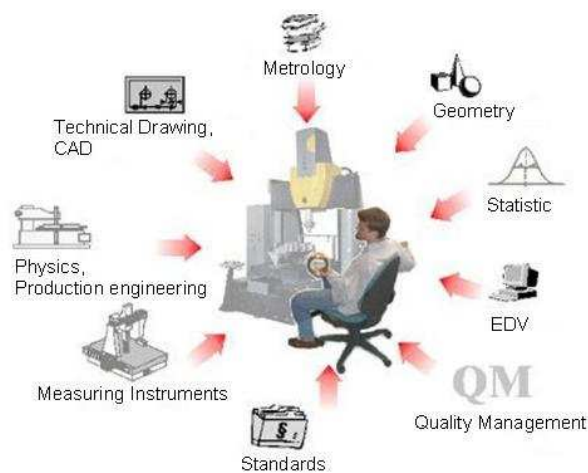


Fig. 2. Operator knowledge required [2]

To minimize deficiencies in today's training offers, *AUKOM* has developed a multi-stage, standardized training concept for operators of measuring systems (irrespective of make) integrated in process cells for the machining of precision tools.

3. DESCRIPTION OF THE NEW CONCEPT

The concept of modular training of tool-making and tool-inspecting process cell operators is based on a differentiation of user levels and subjects. Most tool manufacturers require that measuring systems in the process cell should feature either *single-button* or *menu-prompted operation*, depending on the level of operator know-how.

The concept assumes user groups differentiated by criteria such as vocational training completed, and the current level of know-how in metrology, quality management, design and information technology. Another important criterion is the scope of responsibility within the process cell. Going by these criteria, the following user groups are distinguished:

- Operators
- Programmers in manufacturing (shift managers, machine-setters)
- Programmers in quality management (shift managers, machine-setters)
- System supervisors (department managers)

To ensure general and specific training in the principles of coordinate measurement, quality management and certain areas of design, the *AUKOM* stages described should go into this training concept.

Below, the modular structure of training materials for different user groups is exemplified by a near-process measurement job. In view of user groups with different levels of responsibility, a number of separate dynamic training modules have been created, which form a system of interlinked stages.

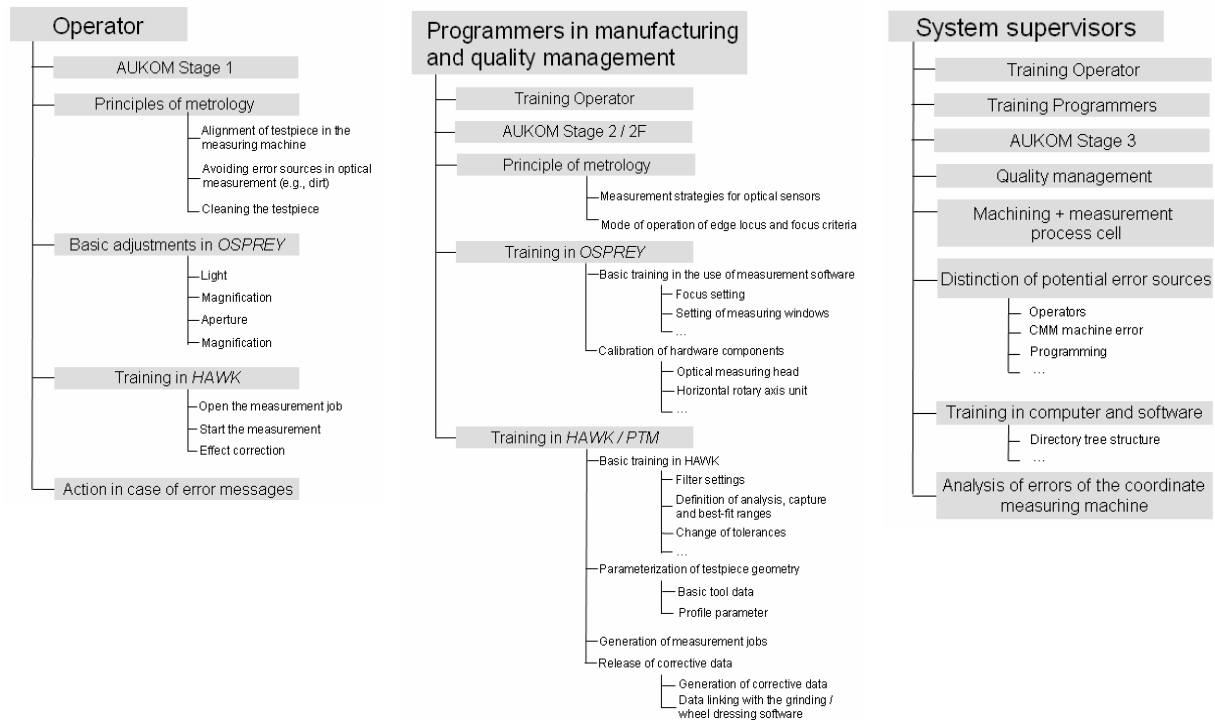


Fig. 3. Schematic diagram of the training module for the group of operator, programmers and system supervisor

As the topics involved are many and varied, these topics should be distinguished according to the following criteria:

- CMM hardware configuration
- OSPREY measurement software
- HAWK analysis and documentation tool
- Measurement job
- Level of knowledge of user groups

Both during installation and during training, exactly those modules have to be combined that are required by the user and the jobs intended. The user should master not less and not more than those hardware and software modules that are actually installed on his CMM.

To be able to develop this new type of dynamic training modules for i-learning systems, use is made of modern information processing technologies. The aim should be to prepare the training materials in standardized formats to allow their fast and easy communication via the Worldwide Web. Thanks to the improved availability of the Internet, i-learning systems are becoming increasingly interesting for the various user groups within the process cell. Modular training with i-learning systems means the simultaneous training of participants actually at different locations but virtually in one and the same room.

4. SUMMARY

The intention of the modular training concept described is to match learning processes to the current qualification requirements of individual levels of machine operators. The training measures are conceived as on-the-job training in combination with Rapid e-Learning.

With regard to information technology, the various training modules are generated in standardized formats. Therefore they can be readily communicated via the Internet. The method has five obvious advantages:

- 1 Training is getting individualized.
- 2 Training is independent of place and time.
- 3 The training modules can be updated at short notice.
- 4 Training costs incurred by the manufacturers and users of measuring equipment are considerably lower compared to classical training methods.
- 5 Training contents are exactly matched to the user's hardware modules.

The new concept of learning makes it possible to hold virtual training courses that permit a synchronous, simultaneous training of several participants at different locations.

In summary, i-learning systems are the further education medium of tomorrow.

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AUTHORS:

Dipl.- Ing.(FH) Franziska Annemüller, Dr.-Ing. Uwe Nehse, Mahr OKM GmbH, Carl-Zeiss-Promenade 10, 07745 Jena, Germany, phone number +49 3641 64 3169, fax number +49 3641 64 3368, e-mail franziska.annemueller@mahr.de, uwe.nehse@mahr.de

Dipl.-Ing. Dietmar Ernst, ESCO GmbH, Jülicher Strasse 134, 52070 Aachen, Germany, dietmar.ernst@esco-aachen.de