MEASUREMENT, INSTRUMENTATION & TEST MANAGEMENT MTM, A NEWCOMER TO EDUCATION & TRAINING

D. Hofmann
Steinbeis Transferzentrum Qualitätssicherung & Qualitätsmesstechnik,
Jena, Germany
E-mail: dietrich-hofmann@t-online.de

*Abstract: The big number of management methods has more than 200 expressions with different names. In alphabetical order one can start with **ABC management**, the abbreviation for adaptive, bioregional & cooperative management [www.orst.edu/instruction] through **Theory Z management** for the improvement of human resource management [www.an.af.mil/database/research].*

***Measurement, Instrumentation & Test Management MTM** [1] is a newcomer to management science and practice [2] as well as to education & training [1]. The mission of MTM is to bridge the gap between the rigid framework of measurement engineering on the basis of legal metrology and the more experienced daily measurement, instrumentation and test practices.*

The purpose of the paper is to provide answers to the questions:

- *WHY do we need MTM*
- *WHAT is MTM*
- *WHAT are MTM standards*
- *WHAT to do in MTM education.*

Keywords: Measurement, Instrumentation & Test Management, MTM

1 OUTLINE OF THE PROBLEM

The big number of management methods has more than 200 expressions with different names. In alphabetical order one can start with **ABC management**, the abbreviation for adaptive, bioregional & cooperative management [www.orst.edu/instruction] via project management PJM [3], process management PCM [4] and total quality management TQM [5] until **Theory Z management** for the improvement of human resource management, within the United States Air Force [www.an.af.mil/database/research].

If you are looking for keywords dealing with measurement, instrumentation and test management, then the University of Maine, Department of Spatial Information Science and Engineering has created a **Measurement Management** Homepage [www.spatial.main.edu].

Jerry Sirmans offers in Advanced Planning Briefing for Industry APBI 1999 under slide 6 an **Instrumentation Management** Office [www.dtc.army.mil/apbi/1999].

Software Quality Engineering SQE San Francisco offers a **Test Management** Course to learn in 3 days what every test manager needs to know.

Measurement, Instrumentation & Test Management MTM [1] is a newcomer to management science and practice [2] as well as to education and training [1]. The mission of MTM is to bridge the gap between

- the rigid framework of classical measurement engineering on the basis of legal metrology, represented by SI and governmental institutes of legal metrology and
- recent daily measurement, instrumentation and test practices, going far beyond the framework of classical measurement engineering.

A typical example for modern measurements is the application of software from global players like National Instruments [www.ni.com] and Microsoft [www.microsoft.com] for measurement, instrumentation and test purposes.

This paper is not the final result of the new destination but possibly an orientation on the way to it.

It is my sincere hope that by modifying our traditional standpoint on education and training in measurement and instrumentation we can discover a new framework

- with more convenient and easier tackling of education and training in measurement, instrumentation and testing and
- with faster development of comprehended and standardised methods in our most favourite discipline with challenging demands to modern theories and practices to solve measurement, instrumentation and test problems in research laboratories and production floors.

2 WHAT IS MEASUREMENT, INSTRUMENTATION & TEST MANAGEMENT?

Measurement, instrumentation & test management MTM is the preparation, planning, realisation and conclusion of measurement, instrumentation & test processes (actions, activities, operations, procedures) to acquire new knowledge for the solution of complicated situations.

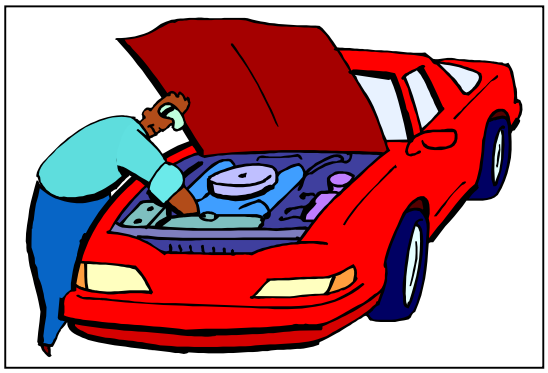
A **situation** is an information or individual consideration, which forces a person to solve a problem. The situation recognition is personalised. Whether a situation is recognised as simple or complicated depends on the person concerned.

A **simple situation** is characterised by the fact that the person has all knowledge which is necessary to solve the problem. He or she feels unburdened (happy). Measurements or tests in simple situations are **not** necessary (Table 1).

A **complicated situation** is characterised by the fact that the person does **not** possess all knowledge which is necessary to solve the problem. The person himself or herself feels burdened (unhappy). Measurements or tests are necessary to solve complicated situations (Table 2).

Table 1. Simple situation

Table 2. Complicated situation



If the fundamental purpose of measurements and tests is to acquire new knowledge to solve complicated situations in the natural or artificial environment of human [6], then the immediate aim of measurements and tests is to acquire new knowledge about for mainly

- parameters of natural products what was typical for the agricultural era
- parameters of artificial products what was and is typical for the industrial era
- parameters of artificial services what is typical for the information era (Table3).

Every era has its special priorities to increase the labour productivity (Table4).

Table 3. Direct aims of measurements

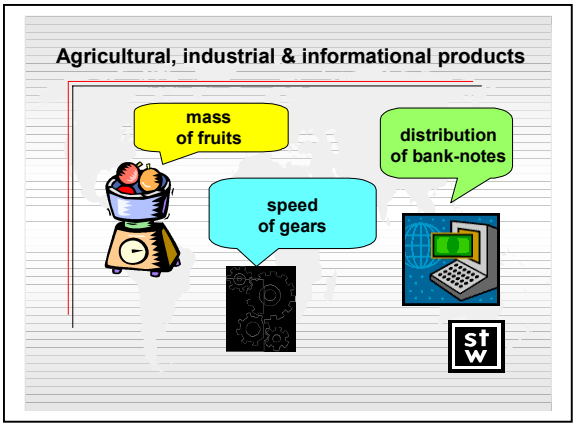
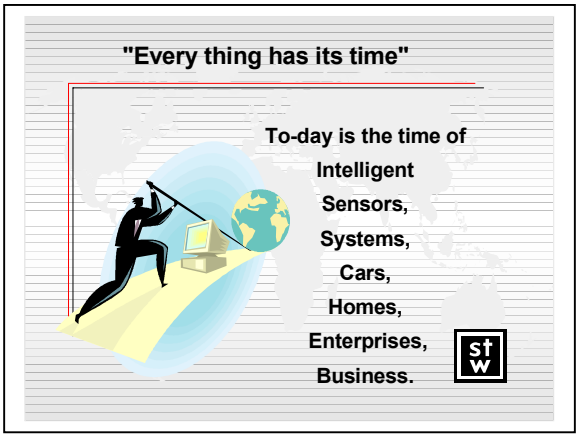


Table 4. Modern demands to measurements



For measurement and test purposes, **natural (biological)** and **artificial (technical)** as well as **mixed** measurement & test processes are used (Table 5).

The fundamental difference between **measurement and test processes** is determined by the application of different standards for the comparison of the measurement or test objects with the measurement or test standards (Table 6).

Table 5. Measurement & test processes

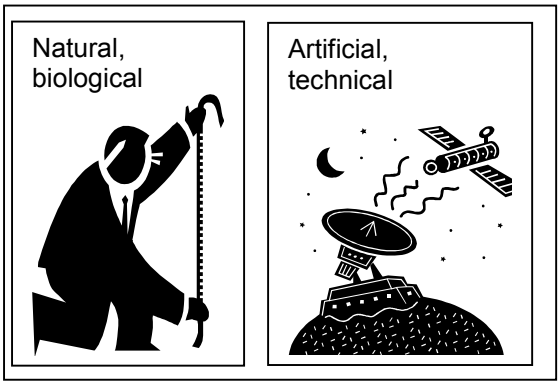
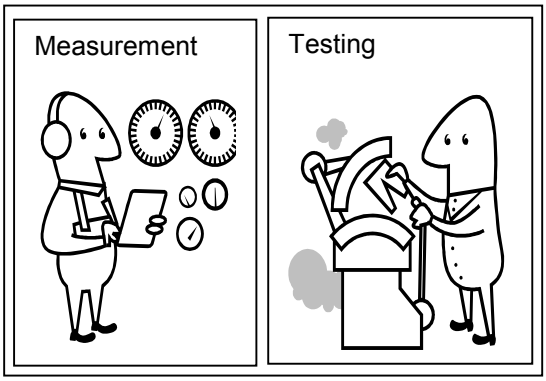


Table 6. Measurement & test standards



Classical measurement is defined as the direct or indirect comparison of a measurement object with a metrological measurement standard (Table 7).

The SI based metrological measurement standards are Meter m, Kilogram kg, Second s, Ampere A, Kelvin K, Mol and Candela cd [www.ptb.de; www.bipm.org; www.nist.gov].

Measurement, instrumentation and test management MTM is defined as the direct or indirect comparison of a measurement or test object with metrological, particular, virtual objective or virtual subjective measurement and test standards (Table 8).

Table 7. Classical measurements

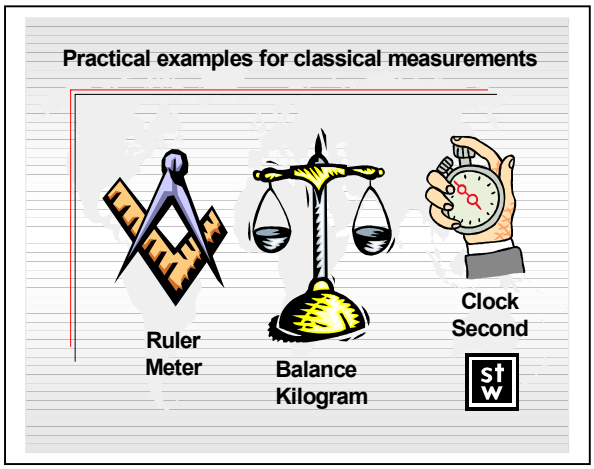
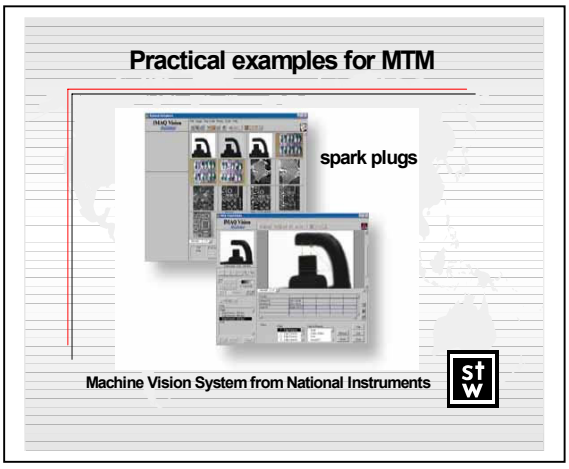


Table 8. Modern measurements



3 WHAT ARE MEASUREMENT AND TEST STANDARDS?

A **metrological** measurement standard is a measuring instrument for definition, physical realisation, deposition and reproduction of a unit of a physical measurement quantity in order to transmit it to other measuring instruments by comparison (Table 9).

A **particular** measurement standard is an objective pattern for definition, physical realisation, deposition and reproduction of identifying marks ot an object or process to transmit it to other objects or processes by comparison (Table 10).

A **virtual objective** measurement standard is a software program or a database for definition, numerical, verbal or graphical realisation, deposition and reproduction of identifying signs at an object or process to transmit it to other objects or processes by comparison (Table 11).

A **virtual subjective** measurement standard is a subjective perception with alpha-numerical, mathematical, graphical or verbal symbols in the brain of one or several experts for definition,

deposition and reproduction of identifying marks at an object or process to transmit it to other objects or processes by comparison (Table 12).

Table 9. Metrological standard

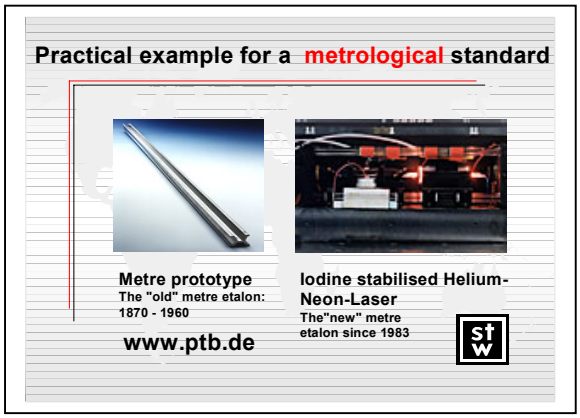


Table 10. Particular standard

Table 11. Virtual objective standard

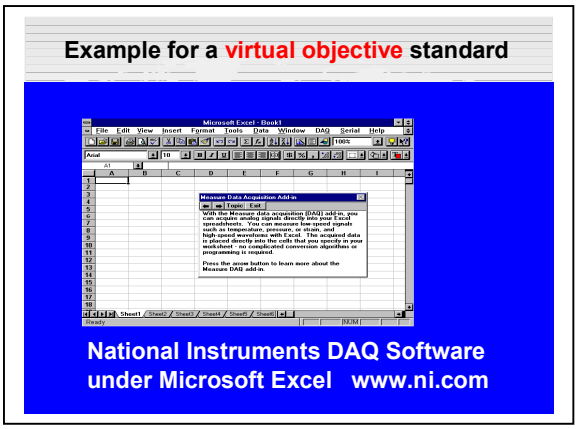


Table 12. Virtual subjective standard

4 FUTURE TASK IN EDUCATION & TRAINING

For a **future task** in education & training in measurement & instrumentation the body of knowledge in measurement, instrumentation & test management **BoK MTM** should be compiled. All kinds of measurement and test standards, scales and performances (Table 13) and the human measuring system (Table 14) should be included.

Table 13. Modern body of knowledge

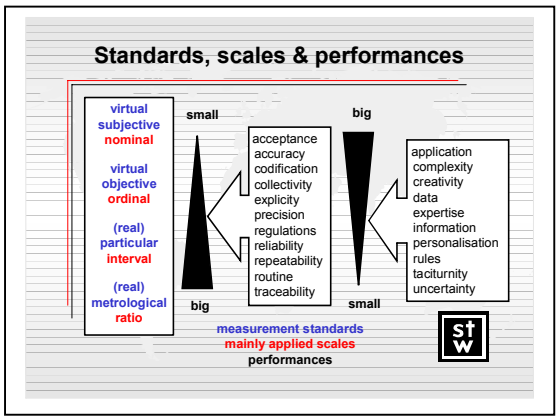
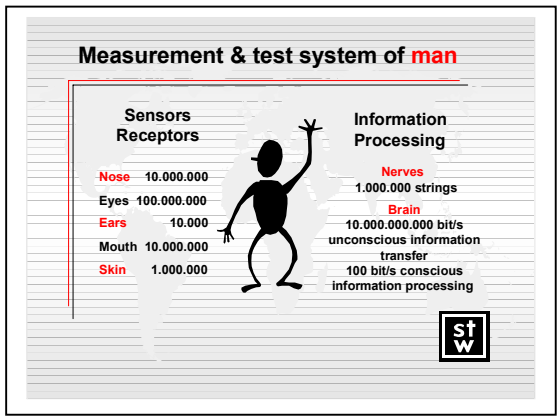


Table 14. Human measuring system



5 CONCLUSIONS

The purpose of the paper was to introduce of a new viewpoint concerning measurement, instrumentation & testing (Table 15.)

The classical understanding and teaching of measurement engineering in theory and practice is too conservative with too strong of a focus on physical measurements. It lames behind the progressive development of measurement, instrumentation & test practice.

One signal in this direction is the continuously expanding topics of international measurement congresses like IMEKO World Congresses [www.imeko.org] lacking an adequate measurement theory. Another signal is the first conjunction of the leading international conference and fair for sensors Sensor 2001 with the international conference and fair for material testing MAT 2001 in May 2001 at Nuremberg [www.sensorfairs.de].

The final measure of all things is man (Table 16). He needs a new body of knowledge in measurement, instrumentation & test management BoK MTM. The BoK MTM should include:

1. the rigid definitions and methods of classical measurement theory,
2. the historical achievements of legal and plant metrology,
3. the experiences of institutions for material testing [www.bam.de] and
4. the experiences of governmental and non-governmental inspection services [www.tuev-akd.de].

For a first step the proposed frame of measurement, instrumentation & test management MTM can be used as a working hypothesis [7].

Table 15. Standpoint of MTM

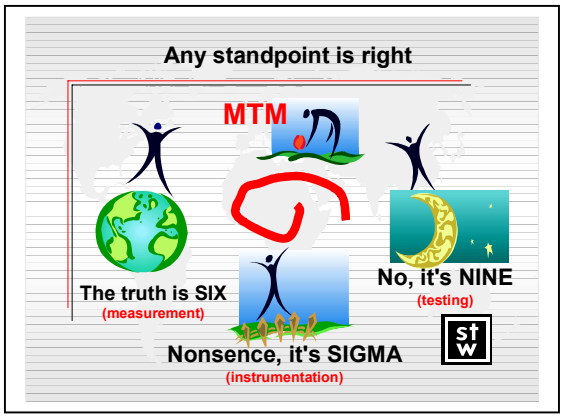
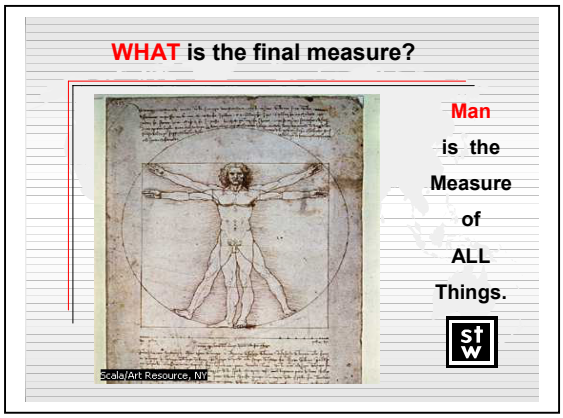


Table 16. The final measure



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