

# **Restructure of CIMO-Guide Part III Chapter 3 (Quality Management of Meteorological Observing Systems): Changes and Supplements**

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## Abstract

CIMO-Guide Part III Chapter 3 for Quality Management of Meteorological Observing Systems have been restructured in consideration of the ISO 9001:2000 standard (requirements for quality management systems) and the ISO 17025 standard (General requirements for the competence of testing and calibration laboratories). The recommendations for changes and supplements will be discussed briefly.

The connection to the WMO-QM-Framework is also included, because the main aspects during the introduction of QMS phases in NMHSs are considered and the QMF will be developed like a guide for the NMHSs which will be certified in the next years.

Additionally the aspects of the IT-Services which influences all measurement techniques in the meteorological observation systems will be introduced in the CIMO-Guide in consideration to the ISO 20000:2005 standard.

## **1. Restructuring the CIMO Guide Part III**

***Task:** Study on how to up-date and restructure CIMO-Guide, Part III, “Quality Assurance and Management of Observing Systems” with respect to international quality management guidelines and relevant ISO standards.*

The structure of the part III should be renamed and rearranged in the order of the included chapters.

The suggested heading could be:

### **— Quality Management in NMHSs and Quality Assurance of Meteorological Observing Systems.**

The Quality management system contains completely all processes in the organization of the NMHS (e.g. Fig.1). Particularly the processes of the leadership, development and general administration processes are included as well in the quality management system (QMS). Therefore all processes are covered by the quality management (QM) providing the fundamental specifications.

The chapters could be arranged like the following:

1. Quality Management in **NMHSs** and Quality Assurance of Meteorological Observing Systems
2. **Quality Assurance:** Testing, Calibration, and Intercomparisons
3. Training of Instrument Specialists **and NMHSs-Employees**
4. Sampling Meteorological Variables **and Data Reduction**

The chapter **Data Reduction** can also be inserted in the chapter **Sampling Meteorological Variables** since it has the same sizes.

## 2. Updating chapter 3 of CIMO Guide Part III

***Task:** Propose, in the form of CIMO-Guide text, how to up-date and re-write particularly Part III, Chapter 3 of CIMO-Guide.*

The chapter should be rearranged and renamed.

The suggested heading could be:

— **Quality Management in NMHSs and Quality Assurance.**

The sub-chapters contain the following topics:

1. General
2. **ISO-9000-Family, QM-Framework of WMO, ISO 17025 and ISO 20000**
3. **Introduction of a QM-System**
4. **Accreditation of Laboratories**
5. **QM-Tools**
6. **Introduction of TQM**
7. Factors Affecting Data Quality
8. Quality Assurance (Quality Control)
9. Performance Monitoring
10. Data Homogeneity and Metadata
11. Network Management
12. **Abbreviations and Definitions of Terms**
13. References

The **subchapters 1, 12 and 13** are self explanatory.

### **Subchapter 2 (Standards, QM-Framework, ISO 17025, ISO20000)**

The chapter gives an explanation of the related ISO standards and their connections with each other. Also the conceptual terms will be explained in detail form in the QM-framework of the WMO. The proposed items are:

#### 2.1 ISO 9000: Quality management systems: Fundamentals and Vocabulary

The used terms are explained and the fundamentals of QM is described. The continuously improvement of the processes is described by the PDCA-cycle.

## 2.2 ISO 9001: Quality management systems: Requirements

The basic requirements for a QMS will be given by this standard.

That have to be completed with a process for improvement- and complaint-management and a process for carrying out amanagemenet-reviews. These processes can also be implemented in the quality manual of the NMHSs.

## 2.3 ISO 9004: Quality management systems: Guideline for performance improvements

The guideline for developement the introduced QMS to business excellence is formulated in this standard.

## 2.4 ISO19011: Quality managment systems: Guidelines for quality and/or environmental systems auditing

Detailed doings for auditing the organization: planning the audits, training the auditors, specification of auditor education.

## 2.5 QM-Framework of the WMO

QM-Framework of the WMO gives the basic recommendations which were got from the experience of the NMHSs. The necessary conditions for a successful certification are summarized and the terms of standards ISO 9001 are explained [8],[9].

## 2.6 ISO 17025: General requirements for the competence of testing and calibration laboratories ISO 17025:2005

This set of rules is applicable for laboratories that want to have their outstanding competence in the field of verification and calibration attested. The differences and the common ground with ISO 9001 are mentioned briefly in fact of harmonizing the requirements of both standards. This standard is devided in two main parts:

- Management requirements (Chapter 4 in [5])
- Technical requirements (Chapter 5 in [5])

## 2.7 ISO 20000: Information technology – Service management – Part 1: Specification, ISO/IEC 20000-1:2005-12 and Part 2: Code of practice, ISO/IEC 20000-2:2005-1

The NMHSs make use of IT-equipment to get e.g. data from the measuring networks or get outputs from GME-/LM-models. The recommendations of the standard according ITIL (IT Infrastruce Library) are helpful for the implementation of reliable IT-services.

### **ITIL**

The ITIL elements Elemente are devided in service delivery and service support with the following processes:

### **Service Delivery**

- Service Level Management
- Financial Management
- IT Service Continuity Management
- Availability Management
- Capacity Management

### **Service Support**

- Change Management
- Incident Management
- Problem Management
- Release Management
- Configuration Management.

The Security management is common to both areas.

It has be taken into account, that

1. the processes have to be adapted to the NHMS organisation and
2. the particular attention is paid to the support of the users

### **Subchapter 3 (Introduction of QM)**

The introduction of quality management depends decisively on the acceptance of the top management. The top management of the NMHSs must publish and live the commitment to the QM-system and support the project team.

The QM-Framework of the WMO gives the basic recommendations which were got from the experience of the NMHSs [9]. The necessary conditions for a successful certification are summarized and the terms of standards ISO 9001 are explained [2].

### **Process organisation in NMHS**

The main processes should be determined according to the guidelines of the organization of the NMHS. These can be part of the named processes (see Fig.1):

- Forecast-processes (Weather-Forecast including hydrometeorological, agrometeorological, human-biometeorological aspects) and weather warning
- Consulting services (including climate and environment)
- Data generation (from measurement nets)
- International affairs
- Research and development (GM-, LM-models)
- Technical Infrastructure (Computing devices (PC, Supercomputer), communication (WLAN), Services for measurement equipment, data management, IT-service management)
- Administration processes (Purchasing, financial and personel-management, organisation, administration offices and immoveables, knowledge management, central planning and controlling, legal affairs)

Even though these processes are going to meet the individual needs of the NMHSs and to provide with sub processes. It is recommended to implement also regulations for the remedying of perturbations and incidents (e.g. failure of systems, accidents of employees).

#### **Subchapter 4 (Accreditation of Laboratories)**

For the accreditation the two following aspects must be fulfilled.

- Management requirements (Chapter 4 in [5])
- Technical requirements (Chapter 5 in [5])

That means,

1. it must exist a QMS and according to this setting the requirements of the standard ISO 9001:2000 have to be fulfilled, i.e.
  - the demanded processes must be described
  - the management handbook must exist including the connections between the processes and the statements to the policy and the goals of the laboratory
  - internal audits and
  - at least a management-review must be carried out.
2. all processes of the laboratory must be approved of the requirements. Especially all processes must be verified and validated in a suitable manner to meet the requirements.
3. Furthermore the parts of QM-representative (respectively quality-manager) and head of the laboratory have to be nominated.

#### **Preparation of accreditation**

The accreditation can be prepared by an extensive documentation of the processes or methods and the internal auditing of the laboratories. Is also essential that the staff used in the examining laboratory gets appropriately trained and have mastered the used processes and methods. The responsibilities also must be regulated obviously. The check of inquiries, offers and contracts which are stressed particularly here. This also includes particularly the subcontract of orders to further calibration laboratories.

#### **Documentation**

The documentation must contain the following aspects:

- management manual for the laboratory
- the process descriptions mentioned in the section 1.2
- the documentation of all processes,/methods
- work instructions for all partial steps in the processes/methods
- equipment books (manual including calibrating certificate)
- maintenance books,

to be in the position to be accredited.

#### **Pre-audit**

With the real accreditation procedure the execution of a pre-audit which can be planned in coordination with the certifying organisation is recommended.

Main emphases are there:

- Assessment of the personnel and spatial prerequisites
- Assessment of the management system on suitability
- Check of the documentation
- Coordination of the scope.

### **Accreditation procedure**

As a rule, the accreditation procedure consists of 2 aspects:

- the assessment of the documentation and
- the assessment of the examining laboratories themselves.

#### **a) Assessment of the documentation**

The assessment of the documentation covers the check of the following documents:

- management manual (or laboratory guide)
- procedure instructions
- work instructions
- test instructions
- equipment books
- maintenance books
- proof documents (e.g. training proofs)
- records (e.g. over correspondences with the customer, calibration certificates, ....)

After requirement it is permitted to the external expert team to request additional documents. All aspects of the standard ISO 17025 are checked unlike a sample like check at the certification corresponding to ISO 9001.

#### **b) Assessment of the laboratories**

The assessment of the examining laboratories contained besides the inspection of the examine and measuring tools

- The assessment of the staff (training, responsibility) and
- The assessment of the rooms.

The following aspects become particularly checked

- Realization of the objectives of management
- Organizational construction
- The qualification of the staff
- Adequacy/qualification of the technological facilities
- Cooperation with the customers.

The laboratory has to establish proof of

- Technical competence (choice and use of the examining and measuring tools)
- Calibration of measuring tools
- Maintenance of measuring tools
- Reduction of the measurements on normals
- Verification and Validation of methods.

This includes corresponding measures like ring tests (so to speak a measure for the benchmarking).

### **Benefits and disadvantages of an accreditation**

The NMHSs prove by an accreditation of their measuring laboratories their competence in the area of meteorological measuring and test methods.

Furthermore these give the possibility for an assessment of the measuring devices provided by suppliers (e.g. the measuring tools in the measure networks of the NMHSs). Also an incalculable importance is given by a uniform data supply in the NMHSs according to WMO standards worldwide.

Disadvantages can be (personnelly and financially) seen in the increased effort. This is particularly valid if the NMHSs which strive for an accreditation of her laboratories have not yet introduced a quality management system.

### **Subchapter 5 (QM-Tools)**

Basic tools of QMS like

- Balanced Score card (BSC) (see Fig. 2 [10])
- Ishikawa
- FMEA
- QFD
- 6 Sigma

for continuous improvement and analysis of the processes of the QMS are described briefly.

### **Subchapter 6 (Introduction of TQM)**

The changed point of view is discussed, that here the existing QMS is developed toward a system according to an excellence model (e.g. EFQM).

## **3 Proposals for Updating chapters 1, 2, 4, 5 of CIMO Guide Part III**

*Task3: Investigate how to adapt the other Chapters to present international quality management guidelines and relevant ISO standards and make proposals in the form of CIMO-Guide text.*

### **Chapter 1 (Sampling Meteorological Variables)**

1. The quality control concept should be added to the text. Additionally the topics of especially chapter 2 (Data reduction) should be merged with this chapter.
2. The chapter 1 should be renumbered to chapter 4.

### **Chapter 2 (Data Reduction)**

1. This chapter should be merged with chapter 1.
2. The subchapter 2.8 Quality management should be renamed to Quality control, because there are only described quality control procedures.

### **Chapter 4 (Training of Instrument Specialists)**

1. The chapter should be renamed in **Training of Instrument Specialists and NMHSs-Employees**, because all other people within the organization have to be trained for instruments and QM-basics.

2. Addition can be made in subchapter **General: IT-Service management**
3. Class I Specialists specification: complete to (h) ....., **Concepts of IT-Service Management**, to (i) ....., **IT-Service Management understandings** and add (n) **QM-Reporting of process indices and related topics**.
4. Class II Specialists specification: add (o) **Carrying out and Monitoring of IT-Services** and (p) **Reporting of process indices and related topics**.
5. Class III Specialists specification: add (k) **Carrying out and Monitoring of IT-Services** and (l) **QMS basics**,
6. Class IV (Instrument content): add (k) **Basic IT Updating and Service procedures** and add (l) **Basic QMS understanding**
7. For Managers: add (d) **basic principles of QM standards (ISO 9000-Family), Accreditation (ISO 17025) and IT-Service-management (ISO 20000)**.
8. For Trainers: add (e) **Continual Improvement in QMS**,
9. For Trainers and Instrument Specialists: add (k) Quality Control (QC) basic concepts from ISO 9001 resp. ISO 17025.
10. Chapter **Training for quality**: Delete: The discipline .... 1986) and replace with **In a QMS according to ISO 9001** ..., and delete TQM and replace with **QMS**.,
11. Chapter Distance Learning: add **Internet** resp. **Elearning via Internet**.
12. References: Correct the citation of ISO Standards.
13. Renumber the chapter from 4 to 3.

#### **Chapter 5 (Testing, Calibration, And Intercomparison)**

1. The second reference (ISO 2859-1) is updated in 1999 and has got a technical corrigendum in 2001.
2. The chapter 5 should be renumbered to chapter 2.
3. The chapter should be renamed to **Quality Assurance: Testing, Calibration, and Intercomparisons**.

## **4 Work process for observation generation**

**Task4:** *Study and draft the work processes typical for observation generation as regards the instruments and methods of observation sector.*

The work process for observation generation is a periodical process and will be commented. The process is almost generic and can be adapted to the specific network of meteorological measurement stations (see Fig. 3).



10 The NMHS monitors the requirements of users and customers (including changes in laws, standards etc...).

20 Requirements from the NMHS processes can cause changes in the sensors and systems. The requested changes will be evaluated.

30 If a change is necessary, then the development will be started.

40 During the development project preventive actions will be taken for reducing the errors and mistakes during the project phases.

50 The testing procedure will finish the development and make a clear verification of the new product, sensor or system.

60 The data acquisition or generation process will be Quality controlled by the preventive maintenance of the sensor or system. During the operation time the validation of the sensors will be carried out. Process indices can be measured (e.g. completeness) and give important information of the processes

70 The generated data must be transferred to the data centre of the NMHS. The functionality and the availability of the system will be controlled by monitoring equipment. The monitoring of e.g. completeness give informations about the robustness of the sensors and systems.

80 The data will be stored in a data base. From this data base they will be controlled by specialized SW-products which measure the consistency of the data. When passing these tests (synoptic plausibility of the data, climatological plausibility of the data) – there will be adapted quality bytes to the checked data – the data will be stored in data centres.

90 No longer used data will be archived.

## 5 References

- [1] International Organization for Standardization, December 2000: Quality management systems – Fundamentals and vocabulary, ISO 9000:2000-12
- [2] International Organization for Standardization, December 2000: Quality management systems – Requirements, ISO 9001:2000-12
- [3] International Organization for Standardization, December 2000: Quality management systems – Guidelines for performance improvements ISO 9004:2000-12
- [4] International Organization for Standardization, December 2002: Guidelines for quality and/or environmental systems auditing ISO 19011:2002
- [5] International Organization for Standardization, August 2005: General requirements for the competence of testing and calibration laboratories ISO 17025:2005
- [6] International Organization for Standardization: Information technology – Service management – Part 1: Specification, ISO/IEC 20000-1:2005-12
- [7] International Organization for Standardization: Information technology – Service management - Part 2: Code of practice, ISO/IEC 20000-2:2005-12
- [8] WMO Quality Management Framework (QMF), First Technical Report, WMO/TD-No. 1268(February 2005)
- [9] Guidelines on Quality Management Procedures and Practices for Public Weather Services, PWS-11, WMO/TD No. 1256, Geneva, Switzerland (2005)
- [10] Kaplan, R. S., Norton, D. P., The Balanced Scorecard, Harvard Business School press (1996)

## 6 Figures

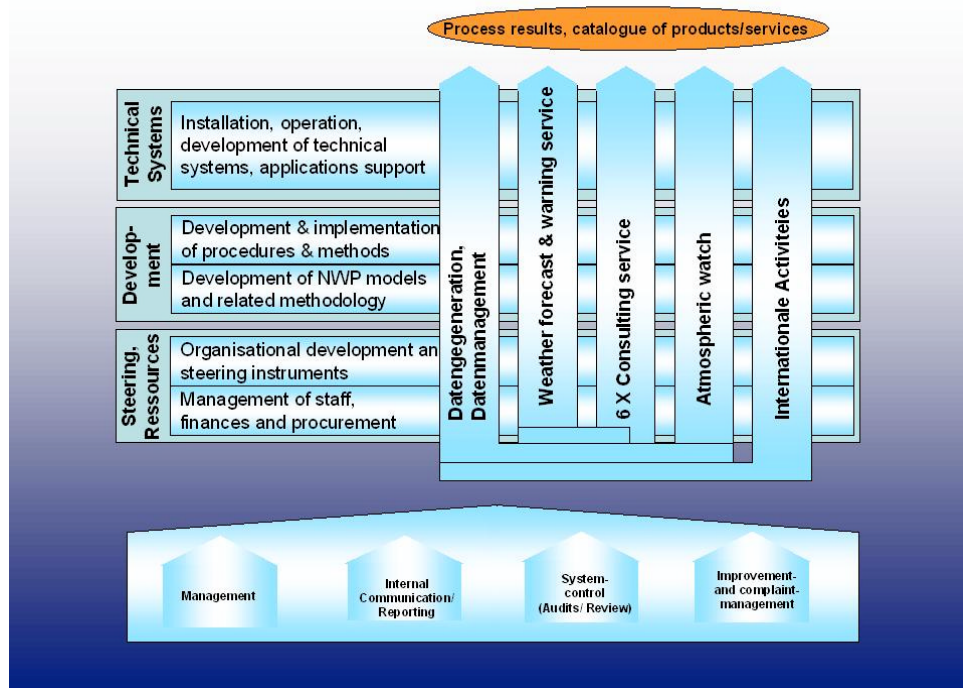


Figure 1: Process landscape of DWD [3].

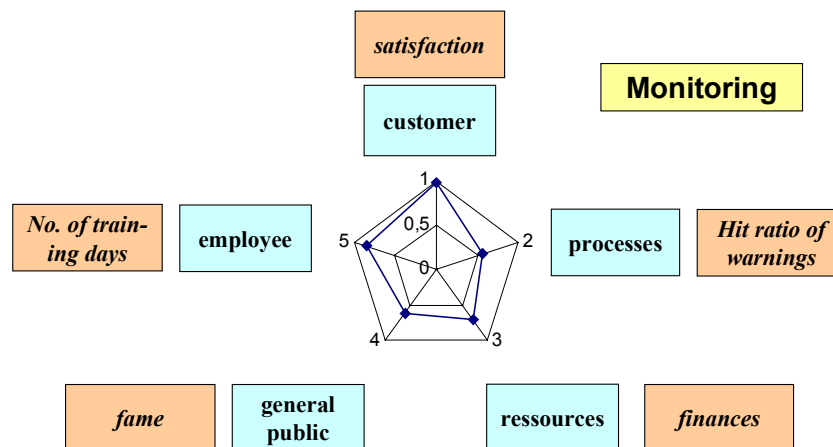
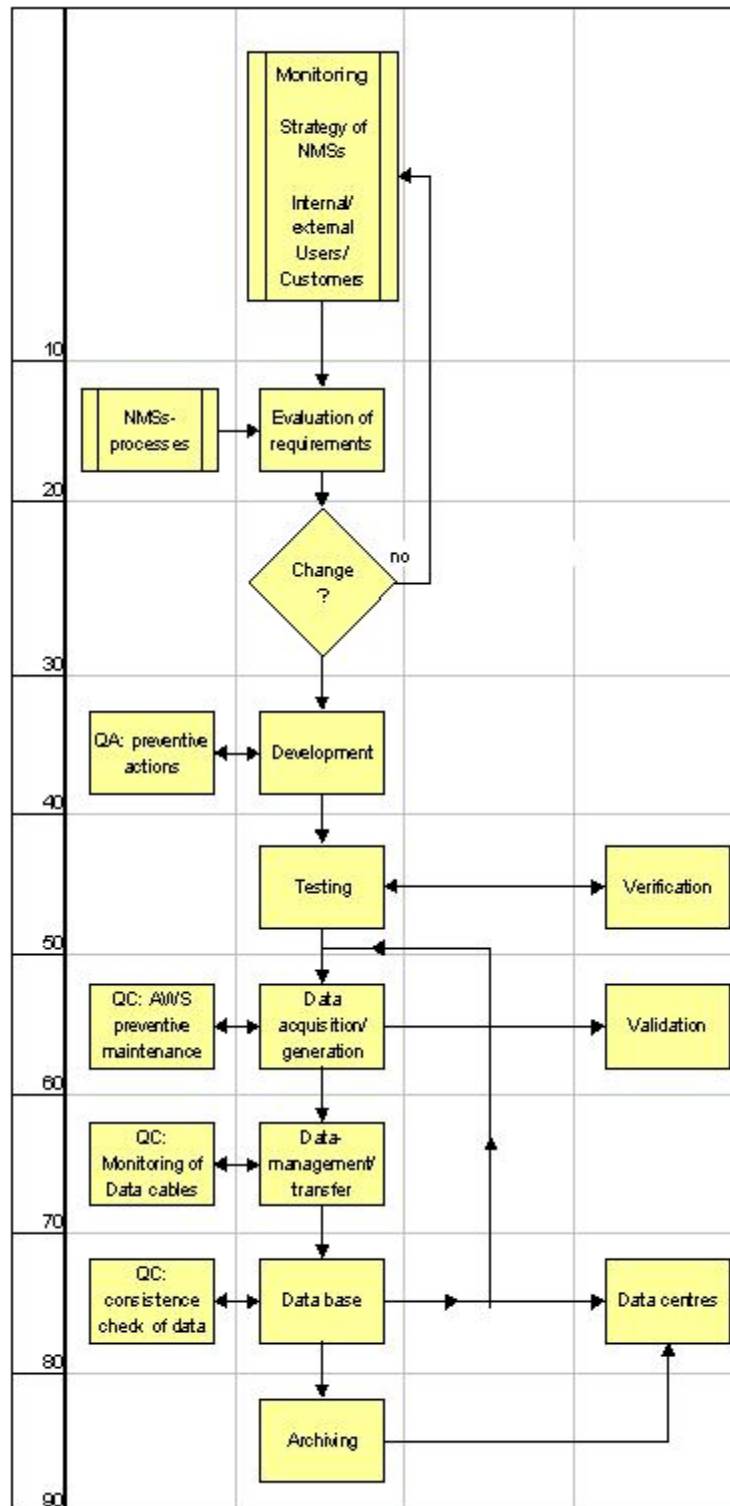


Figure 2: Balanced-Score-Card with 5 positions for the supervision of the success of an organisation. This tool give at least four views of the organisational success to customer, employee, process and resources, what can still be completed with regard to the general public. Also sensible indicators must be consulted for these positions.



**Figure 3:** Process for observation generation.