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REPORT FOR THE WMO
ON QUALITY MANAGEMENT SYSTEMS

Patrick Van Grunderbeeck, November 2001

Foreword : some of the material included in this document originates from the ISO 9000 standard or from the ISO web site (www.iso.ch). This material is provided in *italics*. As the texts of the ISO 9000 series of standards are copyrighted, the author was not in a position to give away the full documents.

I. Introduction

Météo-France is currently implementing an ISO 9000 compatible Quality system in its organization. This was considered as necessary for many different reasons :

1. The growing demand from the general public of products and services they can trust. This factor results in a growing number of court cases in the event of a failure in the safety procedures. Météo-France being part of the chain of responsibilities, is involved in most of the cases. The general public demands as well to be confident that no mistake is made twice : this requires from Météo-France the set up of a continuous improvement process.

2. As a result of the preceding, Météo-France must protect its employees by ensuring that procedures and operating modes are all written down, that they are known by all employees and applied. This transfers the responsibility of mishaps from the employee to the authority who approved the documents. The part of responsibility left to the employee is to apply what he (she) learned during his (her) training.

3. There is a requirement from the ICAO that the meteorological authorities shall build an audited Quality system and that this system should be in accordance with the ISO 9000.

4. There is a growing demand in France from professional customers to their suppliers to be ISO 9000 certified : these customers range for Météo-France from ski resorts to the defense industry or the Defense Ministry itself.

5. To get the certification from an independent organization is only a step forward. This step is very important however : it helps to build a coherent set of documents, and to ensure that this set is managed throughout the years, otherwise the certificate drops.

To enter the certification process does not imply that nothing was done previously : Météo-France had its own set of documents, of course. Some of them had become obsolete along the years without being removed, some were issued several times, etc. It is believed that the set up of a Quality system will prevent those effects from appearing.

Continuous improvement, trust from customers, a reliable documentation, an auditing procedure, are the keywords of Quality.

II. The ISO 9000 series of standards

The ISO 9000 / 2000 series of standards includes :

- ISO 9000 itself : it gives the basic principles of Quality management and details the vocabulary used whilst dealing with Quality.

- ISO 9001 is the standard according which an organization may be certified; in this way it is similar to a "product standard" except that it concerns the way the organization performs, instead of the meteorological product itself.

- ISO 9004 is a list of recommendations for further improvement of the performance, beyond the certification process.

- other standards are linked with the ISO 9000 : the ISO 9000-3, for instance, is the translation of the 9000 applied to software development.

The scope of this set of standards is to provide common sense indications on the best way to manage an organization.

II.1   Vocabulary

Quality : *degree to which a set of inherent characteristics fulfils requirements.*

Requirement : *need or expectation that is stated, generally implied or obligatory.*

Quality management system : *management system to direct and control an organization with regard to Quality.*

Quality policy : *overall intentions and direction of an organization related to Quality as formally expressed by top management.*

Quality objective : *something sought, or aimed for, related to Quality*

Quality control : *part of quality management focused on fulfilling quality requirements.*

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Quality assurance : *part of quality management focused on providing confidence that quality requirements will be fulfilled.*

Continual improvement : *recurring activity to increase the ability to fulfill requirements.*

Process : *set of interacting activities which transform inputs into outputs.* A process uses resources (hardware, software, human resources) and is submitted to constraints or obligations (laws and rules). Processes are linked to each other to form a chain. A process adds value to the inputs. If not, the process can generally be discarded.

Procedure : *specified way to carry out an activity or a process.* It is not compulsory to write down procedures : the decision to do so depends on the ability of the personnel to perform the tasks included into the procedure. However it is compulsory to demonstrate that the tasks are performed adequately, and the procedure is known. In practical terms, because of an unavoidable turnover among the personnel, it is almost always compulsory to write down the procedures.

Audit : *systematic, independent and documented process for obtaining audit evidence and evaluating it objectively to determine the extent to which audit criteria are fulfilled.* The organization shall audit itself to check that tasks are performed according to the procedures, that records are kept, etc. The role of the certification process is to provide an external audit to the organization.

II.2 Principles

The ISO 9000 series is focused on management ; it is governed by eight principles :

a) **Customer focus**
Organizations depend on their customers and therefore should understand current and future customer needs, should meet customer requirements and strive to exceed customer expectations. The customer is the *organization or person that receives a product.* A customer does not necessarily purchase the product ; it can be internal or external to the organization.

b) **Leadership**
Leaders establish unity of purpose and direction of the organization. They should create and maintain the internal environment in which people can become fully involved in achieving the organization's objectives.

c) **Involvement of people**
People at all levels are the essence of an organization and their full involvement enables their abilities to be used for the organization's benefit.

d) **Process approach**
A desired result is achieved more efficiently when activities and related resources are managed as a process. Processes are of different kinds : industrial, scientific or administrative. They exist only because there are expectations to fulfil in order to gain the satisfaction of a client.

e) **System approach to management**

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Identifying, understanding and managing interrelated processes as a system contributes to the organization's effectiveness and efficiency in achieving its objectives.

f) **Continual improvement**
Continual improvement of the organization's overall performance should be a permanent objective of the organization.

g) **Factual approach to decision making**
Effective decisions are based on the analysis of data and information. They should never be based on beliefs or feelings.

h) **Mutually beneficial supplier relationships**
An organization and its suppliers are interdependent and a mutually beneficial relationship enhances the ability of both to create value.

II.3   Quality management system

A Quality management system is a set of activities which are designed to direct and control an organization with regard to Quality. It includes documents such as Quality policy, Objectives, records, etc., as well as a commitment from every part (division/department) of the organization to constantly improve its work.

II.3.1 Documentation
The first aim of setting up a Quality system is often considered as to build up a working documentation. This should be done carefully : the ultimate goal is to encourage the continual improvement of Quality, not to set up bureaucracy.

The Version 2000 of ISO 9001 has considerably improved this field compared to the 1994 version : only 6 procedures are compulsory. *Generation of documentation should not be an end in itself but should be a value-adding activity.*

The case of the working documentation, that contains the know-how of the organization can include documented procedures (i.e. in writing), work instructions and drawings.

More generally, the ISO 9000 states that *each organization determines the extent of documentation required and the media to be used.*

II.3.2 Records
Records shall be kept for traceability every time an activity is associated with a risk : for instance, the risk of not keeping track of the calibration of an instrument being to loose confidence in the data provided, records of the calibrations for each individual instrument shall be kept.

Other records are made necessary through the product realization process : specifications, client's requirements, review reports, etc. shall be kept to prove to the client (for instance an authority) that every task was performed in due course and that the resulting product is in accordance with the requirements or expectations.

Each time there is a mishap (nonconformity or defect, for instance), records contribute to find out how this mishap occurred and help to set up a correction to the process involved in order to avoid further occurrences of the event.

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In this field as well, records shall be kept when necessary and only when necessary. The decision to keep a record (when the type of record involved is not made compulsory by the standard) shall be reasonably evaluated according to risk of not keeping it.

II.3.3 Audits

The ISO 9001 certificate is delivered to the organization after an auditing procedure is performed by a accredited body. In fact, three modes of assessments can be envisaged :

First-party assessment. *This is the technical term used when conformity assessment to a standard, specification or regulation is carried out by the supplier organization itself. In other words, it is a self-assessment.*

Second-party assessment. *This indicates that the conformity assessment is carried out by a customer of the supplier organization. For example, the supplier invites a potential customer to verify that the products which it is offering conform to relevant ISO product standards.*

Third-party assessment. *In this case, the conformity assessment is performed by a body that is independent of both supplier and customer organizations. An example is ISO 9000 certification where an organization's quality management system is assessed by an independent "certification" or "registration" body against the requirements of an ISO 9000 standard. If the system conforms to the requirements, the certification/registration body issues the organization with an ISO 9000 certificate. Such third-party assessment may be required in certain business sectors by government regulations. It may be specified by the customer, or the supplier organization may choose it as a way of differentiating its product or service from others on the market.*

Second party assessment is generally time consuming for both the organization itself and the customer. It should be avoided by building the confidence into the ability, for the organization, to perform its tasks according to requirements of its clients

The third party assessment is the only way to give a general assurance to all customers and specifically to the general public that an organization performs according to the ISO 9001 standard.

In France the auditing procedure is performed as follows :

- the organization sends a demand to be reviewed to the certifying body ; this body sends back an identification form.
- the certifying body requests a copy of the suitable documentation.
- the certifying body visits the organization to be certified in order to check that the procedures are well known, that the documentation was read, that all necessary records are kept, etc.
- the certifying body issues to the organization a series of nonconformities and remarks.
- the organization must then eliminate the nonconformities and answer to remarks.
- the certifying body decides to deliver the certificate or not, according to the answers received.

A certificate is valid only for a period of three years and is subject to an annual audit. After this three year period, the organization shall ask for a new certification.

Audits shall be undertaken internally as well to check that the Quality management system is :

- in conformity with procedures set-up by the organization itself, with the requirements of the ISO 9001 standard,

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- performed and maintained efficiently.

This gives an opportunity to the organization to improve its Quality management system.

   II.3.4 Quality or continual improvement loop
This is a basic but fundamental approach to Quality. The loop gives four keywords that shall be followed by each individual or organization in search of performing better :

P for prepare : prepare yourself to do something, Plan your actions.
D for do : do it as best as you can.
C for check : always check the result of your action, the satisfaction of your client.
A for act : react to the information you were given by your client in order to do better next time.

This very simple model can be applied to major organizations (cf. figure 1) :

- Resource management has the role to Prepare and Plan.
- Product realization is the Do
- Measurement, analysis and improvement is partly Check, partly Act.
- Management responsibility is Act.

III. Benefits of having built a Quality System

As described in the previous section, a Quality System is built whenever the final product or service results from a number of processes performed by a number of persons. The purpose of the Quality System is to ascertain that no mistake is made, or if one is made, that it is not made twice. It shall result in the confidence of the client into the ability of the organization to perform its tasks according to requirements.
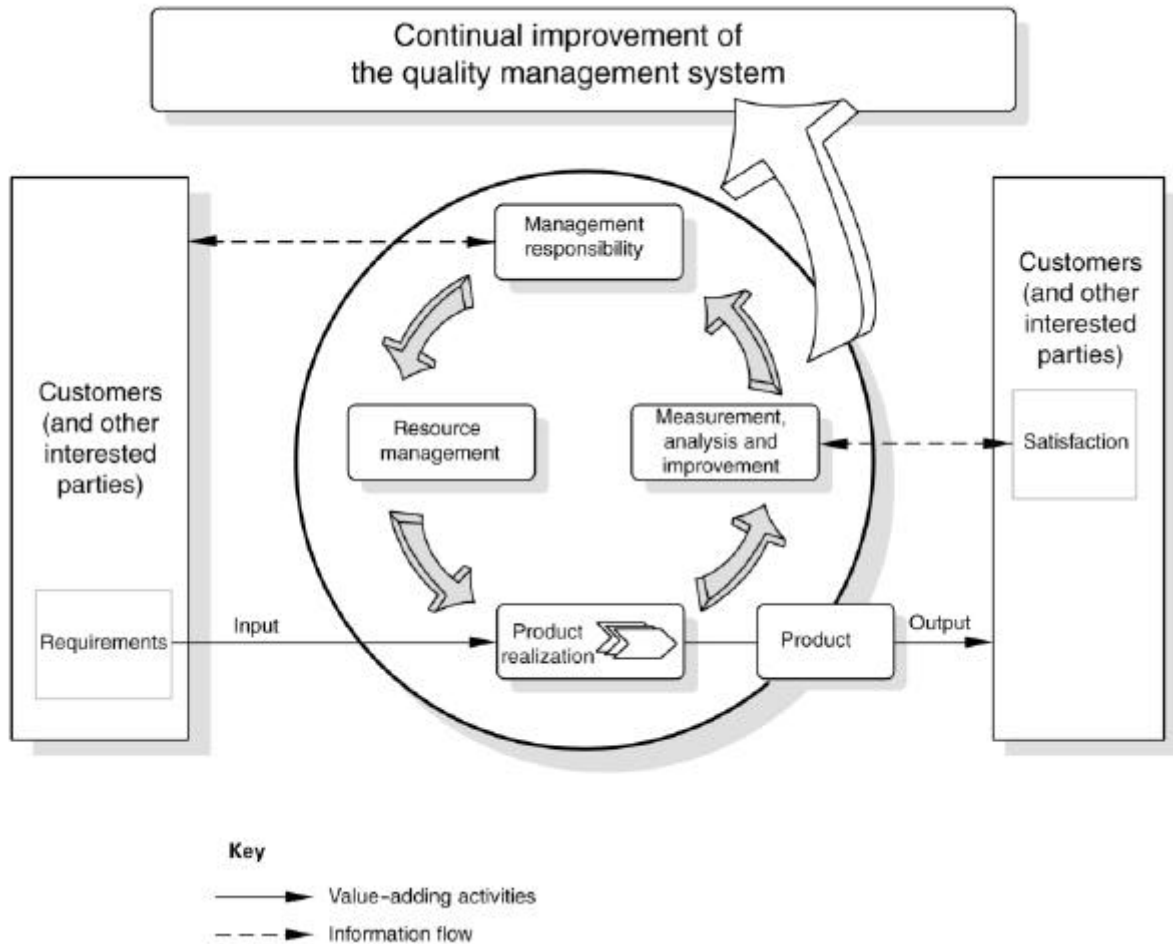
Figure 1 : Model of a process-based Quality management system (statements in parentheses do not apply to ISO 9001. This figure is extracted from the ISO 9000 standard.

III.1   To master one's activities

It is very common for complex organizations not to master every aspect of a production process : every one knows what he (she) does, but does not realize what his (her) work is meant for. One can find this type of situation in the administrative work when forms are exchanged, sorted out, sent, resorted out, etc. One can also very easily find it when meteorologists lose the knowledge of their end users and start to produce weather reports for themselves, or even worse, for their bosses.

To prevent this type of situation, the only way is to make sure that every step of the process is described in writing[*]. The documents shall be made available at any time to the meteorologists and to the employees of the organization. It is therefore very simple to anyone to know (or to retrieve) what is expected from him (her). The knowledge of who is doing what, at any time, is fundamental to the person in charge of a service.

It is not sufficient to know what everyone is supposed to do : one should ascertain as well that it is what is actually done. The way this is carried out through the Quality system is twofold :

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[*] cf. II.3.1

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1. The auditing process (both internally and for certification) ensures that the documents exist, are known by the persons in charge, are available, that the persons are trained, and that they apply the documents to their job.

2. The Quality system compels to keep track of every* key step in the production process. These Quality records may be used to prove that every step was well carried out according to the procedures and operating mode. They keep track, for instance, of every training session attended to by each person : this is made to ensure that everybody is well trained according to the needs of his (her) profession.

III.2 To continuously improve one's performances

The Quality improvement loop is meant to prevent any organization to set aside problems, mistakes, mishaps, errors, without even trying to solve them. It is therefore compulsory for an organization to :

1. Set up a reporting system in order to keep track of events. The related Quality improvement forms are designed to report any wrong event that could have an effect on the final product.

2. Process the Quality improvement reports in order to find out the origin of the failure.

3. Change the procedures and/or the operating modes in order to prevent the occurrence of such events. In the case when the origin cannot be found and/or no answer can be made to the problem, it is at least proved through the tracking system that everything was made to prevent it from appearing again.

III.3 To give confidence into one's ability to deliver products and services of good Quality

The time when meteorology was, like the phone companies, a state monopoly is long gone. One can be pleased with this new situation or not, but it is now a fact. Suffice it to consider the number of private companies dealing with meteorological assistance and the fact that the Meteorological Service of New-Zealand has gone private as a whole.

All these private companies use Quality as a way of proving value to their clients. There is no reason why the state controlled meteorological services should not do the same. On the contrary they must prove to their users, but also to their fellow citizens, that they are able to perform their tasks efficiently. This is a matter of survival for the private companies as they get their revenues directly from their customers. It might well be a matter of survival for the public organizations as well in the near future.

Any exchange on the long range (currency/currency, value/money, product/money, service/taxes) is a matter of confidence : any organization must now prove that it is able to deliver good value products or services.

The only way to gain or to retrieve the confidence of users/customers/clients is to prove that every step was undertaken to satisfy their needs.

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* cf. II.3.2

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III.4 **The case of meteorological services**

The following statement could be discussed :

"There is no fundamental difference between a meteorological service and another public service, or even a private company in charge of a general interest service (transport or water distribution for instance)."

All meteorological services have clients : the states, the other meteorological services (through the WTS), pilots, airlines, users of the meteorological forecasts, the general public, etc.

The service provided to users, or clients, or customers, is information : this information shall be accurate and delivered without any delay in the right form. This is perfectly conceivable for measurements, but quite difficult to understand for forecasting : how can one decide, and check, that a forecast is accurate enough for a given user ?

Everybody can perfectly understand that no meteorological forecast will ever be 100 % certain. As a result, no meteorological forecast is a nonconformity when delivered in time to the right person : it is impossible to check the value of the forecast before the weather confirms this value. The confidence of the users must be built on other grounds, and that is where ISO 9000 standards mean a lot for our profession.

The ISO 9001 certification gives a method to evaluate the Quality of the performance of a service, even if the product itself cannot be checked adequately at the time of delivery : the organization checks itself through first party assessment, and is checked through third party assessment.

Again, the performance of the organization is checked according to its objectives : there is no standard for weather forecast and it is very unlikely there will be one ever, except for forms to be used for specialized services like marine forecast. Thus a meteorological service with limited resources will not be prevented to gain an ISO 9001 certification if its objectives are consistent with its resources, and when it reaches those objectives.

In other words, the third party assessment will judge how the service work rather than its results according to some definite scale fixed by some international body.

It is true however that the ISO 9001 standard is issued by an international body that may appear as a "big brother" organization : the careful wording of the standards indicates very clearly that this suspicion is not backed by reality.

III.4.1 Quality is now a requirement from aeronautical users.

With the growing competition on the market of aeronautical services, and furthermore after the events that took place in September 2001, it is a natural demand from airlines to ask if they get value for the amount of money they pay to get the meteorological information. In some countries like France, there is no competition between meteorological service providers to air services. This is not the case everywhere. Even in France, Météo-France should be aware that this state of fact possibly will end some day in the future : even if such a situation is long from now, there is a growing pressure for Météo-France to open its account books to prove that the right price is paid, and the work is done properly.

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III.4.2 The international meteorological community needs good quality data and forecasts.

One cannot imagine a world in which meteorological data exchanged on the WTS would be deliberately of poor, or of questionable quality : WMO has established standards with which those data shall comply. Unfortunately, there is no procedure to ensure that the standards are actually monitored. It is very unlikely that WMO would ever be in a position to do so. First and third party assessment imagined for Quality management are a way to solve that difficulty, at a reasonable cost for both WMO and the NMHS, without having to set-up procedures that already exist.

III.4.3 In the future, the states will no longer pay for a service if they can procure it at a lower cost from private and/or foreign organizations.

This situation is a real threat to NMHS : they could be confined to the acquisition and transmission of data and to the maintenance of the network of stations. Or even less if the progress in the field of satellite meteorology tends to make unnecessary ground measurements. The service to the many clients for meteorological services could then be addressed through such tools as internet. If one is convinced of the value of a meteorological public service in each country, of private status or not, one should prove the value of such organizations to their clients and to their states. This is particularly true for developing countries, which NMHS could be rapidly overwhelmed by foreign organizations.

IV. Drawbacks of setting up a ISO 9000 compatible Quality System

The build up of a Quality system requires some time and some money. It might also develop into a bureaucratic nightmare if not performed cautiously.

IV.1   The cost of implementing a Quality system

The exercise of giving some ideas about costs is always quite difficult : it may well depend on the country, the step of preparedness of the meteorological service, and the willing of the personnel.

The costs involved for certifying an entity are :

- the cost of the consulting to help the entity.
- the cost of the auditing process for getting the certification.
- the time spent by the personnel.

IV.1.1 Cost of consulting
It is obvious that no meteorological service can start setting up a Quality system without any external help. It is certainly not a matter of not understanding the standards : these are clear and well written. It is a matter of method to be used.

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The help is generally provided by a specialised company, at a cost. To give an idea the cost for an entity of about 350 persons in France is 110 000   , or US$ 100,000. This includes any expense incurred over a period of two years.

Météo-France has set up a program of "Internal consultancy" to help reduce these costs : the training of the "internal consultants" has a cost however : 60 000   , or US$ 54,000 for 12 persons fully trained.

IV.1.2 Cost of the auditing process

This cost is twofold. The ISO 9000 requires the set up of an internal auditing procedure which costs in terms of training, time (cf. IV.1.3), and travel expenses. It requires an annual audit from an accredited organization to keep the certificate alive.

1. Internal auditing procedure

The cost of training in France for a group of 12 auditors is about 20 000   . Météo-France will need a pool of 30 to 50 auditors when it is fully certified.

The travel expenses depend very much on the distance between the auditor and the service he (she) will audit. An average of 300   is about right. There will be approximately 250 such internal audits per year for Météo-France.

2. Certification audit

The cost of such an audit depends very much on the number of sites involved, as well as the number of employees to audit. Météo-France expects to spend about 75 000   per year in auditing expenses to keep its certificate.

IV.2   Dangers associated with the ISO 9000 standards

If not understood correctly nor applied properly, the ISO 9000 standard can result into bureaucracy, authoritarianism, dogmatism, and a general feeling of discouragement.

IV.2.1 Bureaucracy and dogmatism

Bureaucracy in the sense of creating many documents, forms, records, without keeping in mind the overall efficiency of the organization is the major threat. It is very often associated with dogmatism : after a while, the Quality management system is run by "Quality specialists" independently from the product realization.

Let's say it was a real danger with the previous version of the standard (version 94). As the focus is placed on efficiency with the 2000 version, an organization that has developed a useless system shall not be delivered any certificate any more.

The danger still exists, though, and that's why the standard is very precise on this point : *generation of documentation should not be an end in itself but should be a value-adding activity.*

IV.2.2 Authoritarianism

The ISO 9000 standard states that *leaders establish unity of purpose and direction of the organization. They should create and maintain the internal environment in which people can become fully involved in achieving the organization's objectives.*

This statement could be understood by some as an encouragement to be more authoritarian than necessary. They could take advantage of some of the quality checks to track down the "bad

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workers". The necessary records could also make the ground for a system in which every mistake is recorded.

Such managers should read carefully the third principle as well : *people at all levels are the essence of an organization and their full involvement enables their abilities to be used for the organization's benefit.* It is generally believed by Quality consultants that mistakes, errors, faults are the result of a combination of factors in which the management takes part : directly, by misleading the person involved, or more generally by not providing the suitable training or information, without mentioning the working environment.

IV.2.3 Discouragement
The term Quality is very often associated with Quality check : the personnel has the feeling that the ultimate goal of it is to check their work and to give a scheme to the direction that will lead to more work and more constraints, if not ways to justify redundancies. This feeling of being the victim of a dehumanized system is very common and shall be really carefully controlled by the management. The directors shall be the first ones to be convinced this is not the case, and that it is quite the reverse situation : nothing is the objective of Quality but better work to the satisfaction of the client and other interested people, among which are the persons working for the organization.

It is well known that a project that takes too long to complete is a source of discouragement for the personnel. Quality is a complex matter and should suffer no lack of pace. It is therefore highly recommended that each individual Quality project takes not more than eighteen months to two years to complete.

V. The role of WMO regarding Quality

This paragraph has no intention except to suggest a few guide lines to WMO regarding Quality.

WMO has long established rules and standards regarding some aspects of Quality (measurements, formats, etc.). However it has never gone to the point where meteorological standards could be evaluated regarding these standards. The worldwide well recognized ISO 9000 set of standards is an opportunity for WMO to go further and to set up new rules regarding those practices.

WMO is not in a position to prevent some of the meteorological services to go certified. In that respect, it is true that a two speed meteorological world service is developing.

V.1   Positive view on Quality management

It is suggested that WMO adopt a positive view on Quality management system and consider the development of such systems, not as a threat, but as a real opportunity to get the work of the meteorologists of the world recognized as highly professional.

V.2   Help to the NMHS

It is suggested that WMO should help the NMHS, and particularly those of the developing countries to gain an ISO 9001 certification.

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This could be done in several different ways :

- to set up a basis (a kit) of documents, including different process analysis to chose from, as recommendations from WMO to set up a quality management system
- to encourage visits from quality managers from different NMHS having developed a Quality system to other NMHS, particularly in the developing countries.
- to set-up a network of international consultants to NMHS, whose consultancy would be provided free of charge to the NMHS depending on the size/NGP of the country ?
- to provide financial support to NMHS to pay for their initial certification ?

VI. Conclusion

To be added...

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