Guide to the Implementation of a Quality Management System for National Meteorological and Hydrological Services

2013 edition

World Meteorological Organization

Weather • Climate • Water

WMO-No. 1100

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EDITORIAL NOTE

METEOTERM, the WMO terminology database, may be consulted at: http://www.wmo.int/pages/prog/lsp/meteoterm_wmo_en.html. Acronyms may also be found at: http://www.wmo.int/pages/themes/acronyms/index_en.html.

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PREFACE

The purpose of this document is to provide guidance on how to develop and implement a quality management system (QMS) to ensure and enhance the quality of products and services provided by National Meteorological and Hydrological Services (NMHSs). It also details the steps needed to obtain certification of compliance of an organization's QMS with the International Organization for Standardization (ISO) Standard *ISO 9001:2008, Quality management system – Requirements* (ISO 9001).

The Guide is based on the significant practical experience gained during the development and implementation of QMSs by a variety of organizations combined with the collective wisdom of the resource material available from NMHSs with mature QMSs and organizations such as ISO.

This document will be available in hard copy, but the prime publishing format will be that of an on-line foundation document on the WMO Quality Management Framework (WMO-QMF) Website (http://www.bom.gov.au/wmo/quality_management.shtml). Wherever possible, the Guide will provide hyperlinks to other resources to ensure, as much as possible, the longevity of the document in terms of its currency and ongoing value.

The Guide is primarily a Web-based living document and, in line with the quality management principle of continuous improvement, it will be reviewed, amended and updated on a regular and ad hoc basis. Input from NMHS quality management practitioners will always be welcome and included on a consensus basis.

We would like to thank Bryan Boase, lead author, Helen Tseros, Geoff Gray and Neal Moodie, contributors, and Chi Ming Shun and Herbert Puempel, advisers, who were instrumental in the publication of this guide.

TERMINOLOGY, VOCABULARY, ABBREVIATIONS AND DEFINITIONS

The quality management system (QMS) terminology, vocabulary and definitions used throughout this Guide are those of the International Organization for Standardization (ISO) and, in particular, those identified in *ISO 9000:2005, Quality management systems – Fundamentals and vocabulary*. The meteorological and aviation terminology, vocabulary, abbreviations and definitions used in this document are those of the World Meteorological Organization (WMO), the International Civil Aviation Organization (ICAO) and other organizations as appropriate.

A brief description of the quality management terminology most frequently used in this Guide is given below. However, it is to be borne in mind that definitions may vary slightly depending on the industry and community sector.

Certification and registration: depending on the region in which the National Meteorological and Hydrological Service (NMHS) is located, the terms certification or registration may be used. For the purpose of this Guide, the term certification will be used.

Customer: in WMO clients and customers are usually referred to as users. However, the ISO family of standards exclusively uses the term customer so, in order to ensure clarity and consistency, the term customer will also be used throughout this Guide.

Products and services: for the purposes of the ISO 9000 family of standards, any reference to products also includes services.

Quality: there are many definitions and interpretations of quality but they all have one element in common: quality refers to the perception of the extent to which a product or service meets the customer's expectations. It should be noted that quality has no explicit meaning, unless it is related to a specific set of requirements. To highlight this, ISO defines quality as the degree to which a set of inherent characteristics fulfils requirements.

Quality management (QM) is a process that focuses not only on the quality of the product but also on the means to achieve it. It is centred on the following four activities: quality planning, quality control, quality assurance and quality improvement.

Quality management system (QMS): the organizational structure, procedures, processes and resources needed to ensure the delivery of an organization's quality products and services. NMHSs are encouraged to undergo third-party certification of their QMS to achieve compliance with the ISO Standard *ISO 9001:2008, Quality management systems – Requirements*. This is discussed later in the Guide.

Quality control (QC) aims to ensure that quality requirements have been fulfilled prior to the dissemination of a product or the delivery of a service.

Quality assurance (QA) aims to instill confidence that quality requirements have been met. It involves the systematic monitoring and evaluation of the processes associated with the generation of a product or service.

Stakeholder: any individual or organization that can impact positively or negatively on the activities of the NMHS, or any individual or organization that can be positively or negatively affected by the activities of the NMHS .

CHAPTER 1. INTRODUCTION

1.1 A brief history of quality management

1.1.1 The quality movement has its roots back in medieval Europe, in the late 13th century, where craftsmen organized themselves into guilds. Up until the early 19th century, manufacturing in the industrialized world continued to follow this guild model. In the mid-1750s, the factory system, which emphasized product inspection, was introduced in Great Britain and developed into the Industrial Revolution in the early 1800s. The Industrial Revolution led to a system in which large groups of people that performed similar work were brought together under the supervision of an individual who was appointed to control the quality of work being undertaken.

1.1.2 In the mid-1920s, Walter Shewhart, a statistician with the Bell Laboratories, broadened the focus on quality to include not only the finished product but also the processes needed to achieve that quality. He recognized that the processes provided valuable data that could be analysed using statistical techniques to ascertain whether or not a process was providing the optimum outcome or required refinement to deliver the expected level of quality. To this day that activity still plays a key role in any quality management system (QMS).

1.1.3 Another statistician, William Edwards Deming, referred to at times as the "father of quality management", was an advocate of Shewhart's methods and, in his own right, became a leader of the quality movement in both Japan and the United States. Deming triggered a revolution in manufacturing which led to a significant improvement in product quality. His influence in Japan, through his quality management initiatives, was a key driving force behind the country's economic rise in the period after World War II. In the 1970s, many major public and private sector organizations published their own quality management standards, which introduced the idea that confidence in a product could be gained through an approved quality management system and quality manuals.

Growing international trade stimulated the development of internationally recognized quality management standards. It was feared that a variety of national standards would emerge and become a barrier to international trade. It was recognized that there was a need for an international standardization system and this led to the establishment of the International Organization for Standardization (ISO) that we know today.

1.2 The primary drivers for adopting a quality management approach in National Meteorological and Hydrological Services

1.2.1 The adoption of a quality management approach to the delivery of products and services of National Meteorological and Hydrological Services (NMHSs) has been driven by a number of imperatives. A key imperative has been the requirements of the International Civil Aviation Organization (ICAO) for the delivery of aviation weather services.

1.2.2 The International Civil Aviation Organization first introduced quality-related standards and recommended practices in its Annex 15 – *Aeronautical Information Services*, in November 1997. It was recognized that in the field of meteorological service for international air navigation quality management had become increasingly important and there was a need for a properly organized quality system to ensure continued high quality of data and products provided by the aeronautical meteorological services.

1.2.3 Amendment 72 to ICAO: *Annex 3 – Meteorological Service for International Air Navigation* and WMO*: Technical Regulations, Volume II - Meteorological Service for International Air Navigation, C.3.1*, (WMO-No. 49) came into force in November 2001. It introduced recommended practices concerning quality control and management of meteorological information supplied to users and in the training of meteorological personnel. These practices, which recommend conformity with the ISO 9000 series of quality assurance standards, can be found in the above-

mentioned ICAO *Annex 3* and WMO *Technical Regulations,* C.3.1, Section 2.2, 2.2.2 to 2.2.6. To assist WMO Members and ICAO Contracting States in developing quality management systems of their own, WMO and ICAO jointly developed and published in 2006 *Guide to the Quality Management System for the Provision of Meteorological Service for International Air Navigation* (WMO-No. 1001) to facilitate the design, development and implementation of an ISO 9000-compliant quality management system by the aeronautical meteorological services.

1.2.4 The ICAO Council at its 189th Session considered Amendment 75 to Annex 3, which raised the recommended practice pertaining to quality management systems for aeronautical meteorology to a standard. At the time, it was recognized that many States were not ready to implement a QMS and it was decided that it should apply as of November 2012.

1.2.5 The World Meteorological Organization first addressed quality management in May 2003, at the Fourteenth World Meteorological Congress. Congress adopted Resolution 27 (Cg-XIV) – Quality Management, and decided that WMO should work towards a Quality Management Framework (QMF) for NMHSs that would include the following elements to be dealt with on a phased basis: (a) WMO technical standards; (b) quality management systems including quality control; and (c) certification procedures. Congress also requested the Executive Council to guide the development of the WMO Quality Management Framework (WMO-QMF) by providing broad guidelines for NMHSs on how to develop their quality management system.

1.2.6 In October 2004, a WMO Workshop on Quality Management was held in Malaysia to address the recommendations of the 56th Executive Council, in particular the adoption of the WMO-QMF. The Inter-commission Task Team on the Quality Management Framework was established to oversee and coordinate the activities and monitor progress of the WMO-QMF as it was developed and implemented. In November 2005, a WMO seminar on quality management focusing on the provision of meteorological services to aviation was conducted in Hong Kong, China.

1.2.7 The first session of the Inter-commission Task Team on the Quality Management Framework was held in April 2005. The meeting reviewed possible ways of establishing closer working relations with ISO in order to develop technical standards relevant to the Organization, which would broaden the application and recognition of WMO standards. The meeting recommended that WMO be recognized as an international standardization body by ISO, which was achieved in December 2007. This recognition aimed to strengthen the development of international standards and to avoid duplication of work on standards related to meteorological, climatological, hydrological, marine and related environmental data, products and services. The World Meteorological Organization and ISO would develop, approve and publish common standards based on WMO technical regulations, manuals and guides, which would clarify the authority of WMO documents and enhance their international recognition and dissemination.

1.2.8 The World Meteorological Organization affirms the urgency of supporting the implementation of QMS by Members in their services for international civil aviation. It also recognizes the developments in other areas where partner organizations are requesting the implementation of QMS for services to them. Overall WMO is aware of the high importance of having quality management systems underpinning many aspects of the work of the Organization and its Members.

1.2.9 The adoption of a QMS should be a strategic decision of an NMHS whose specific needs, objectives, activities and size will influence the development and implementation of the QMS.

1.2.10 There is a misconception that the adoption of a quality management approach to the delivery of NMHS products would be an expensive activity, which increases significantly the workload and adds extra layers of bureaucracy. However, if it is well planned, appropriately resourced and efficiently implemented, it will provide a cost-effective management system.

1.2.11 There is a comprehensive set of WMO technical regulations and guidance documents that provides a sound foundation for the operation of an NMHS. In addition, ISO 9001 provides a rigorous management framework that will enable an NMHS to identify and meet the requirements of its customers, monitor and measure its own performance and identify opportunities to continually improve its service delivery.

CHAPTER 2. QUALITY MANAGEMENT AND THE INTERNATIONAL ORGANIZATION FOR STANDARDIZATION

2.1 The International Organization for Standardization

2.1.1 International standardization started in 1906 with the International Electrotechnical Commission which focuses on the electrotechnical field. The International Federation of the National Standardizing Associations, which had a strong focus on mechanical engineering, was formed in 1926 but was disbanded in 1942 during the Second World War.

2.1.2 In 1946, delegates from 25 countries met in London and decided to create a new international organization, whose objective would be to facilitate the international coordination and unification of industrial standards. The new organization – ISO – officially began operation on 23 February 1947.

2.1.3 The International Organization for Standardization is the world largest developer of international standards and since 1947 it has published more than 18 500 standards, in areas ranging from agriculture, construction, mechanical engineering and medical devices to the newest information technology.

2.1.4 When this guide was published there were 164 ISO members divided into the following categories: member bodies, correspondent members, and subscriber members.

2.1.5 Since the acronym for the International Organization for Standardization would have varied, depending on the language used (for example IOS in English and OIN in French for Organisation internationale de normalisation) the founders of the Organization chose a short, all-purpose name – ISO – which is derived from the Greek *isos*, which means equal. As a result, whatever the country or language, the short form of the organization's name is always ISO.

2.1.6 For further information regarding ISO, we recommend the book *Friendship Among Equals* by Jack Latimer. The ISO Website (http://www.iso.org/iso/about.htm) also offers a wealth of valuable information.

2.2 The ISO 9000 family of standards

2.2.1 In 1987, an ISO committee chaired by Canada developed an international quality standard based on the then British Standard BS 5750, which was the first of the ISO 9000 series. Since 1987, this series has grown and now includes associated guidelines applicable to particular industries. However, at this time, there is no specific guide for the delivery of products and services of NMHSs.

2.2.2 ISO 9000 comprises two kinds of quality management standards: requirements and guidelines. The entire series consists of the following three standards, which represent an international consensus on good quality management practices:

(a) *ISO 9000:2005, Quality management systems – Fundamentals and vocabulary.* This Standard describes the fundamentals of quality management systems and specifies the terminology used in ISO 9000.
(b) *ISO 9001:2008, Quality management systems – Requirements.* These requirements can be applied to all types of organizations, both in the public and private sector, regardless of size or industry group. They can help both product and service organizations achieve standards of quality that are internationally recognized and respected throughout the world. It is the only Standard in the ISO family against which organizations can be certified (or registered) through a third-party audit process.
(c) *ISO 9004:2009, Managing for the sustained success of an organization – A quality management approach.* This Standard focuses on achieving sustainable success in today's complex, demanding and ever-changing environment by meeting the needs and expectations of

customers and other stakeholders. An interesting facet of this Standard is that it promotes self-assessment as an important tool, which enables ongoing review of the level of maturity attained by the QMS. However, it should be noted that the self-assessment tool is not a substitute for a third-party audit process, which is fundamental to ISO 9001.

2.3 The importance of the ISO family of standards

2.3.1 The ISO 9000 family of standards, and in particular ISO 9001, is important because of its international orientation. It has the support of national standards bodies from more than 150 countries and is, therefore, the logical choice for an organization such as WMO and its Members. WMO and the NMHSs of its Members operate in an international environment and have customers who demand an international standard of excellence.

2.3.2 The adoption of a quality management approach to the delivery of products and services may require a significant change management strategy for many NMHSs. ISO 9001 provides an appropriate framework to implement the required change management processes. The framework helps identify the most appropriate policies, procedures, records, technologies, resources and structures needed to achieve and enhance the quality of products and services of NMHSs. The development and successful implementation of a QMS will instil a quality attitude at all levels of the NMHS, which in turn will help to ensure the delivery of products and services of an international standard.

2.4 Corporate governance and ISO 9001

2.4.1 In simple terms, governance relates to the processes and structures that ensure an organization is directed, controlled and held to account. It focuses on how an organization is managed, how risk is monitored and how value is added for the community, government and other stakeholders.

2.4.2 National Meteorological and Hydrological Services predominantly operate in a public sector environment. Public sector governance covers a wide spectrum of activities focusing on how an organization meets the requirements of legislation and its government-determined outcomes, how it expresses its culture and values, and how it acquits its stewardship responsibility by being open, accountable and prudent in decision-making, in providing policy advice as required, and in managing the delivery of government programmes.

2.4.3 Good public sector governance provides a foundation for high performance, strengthens community confidence in the organization and helps to ensure an organization's reputation is maintained and enhanced. The main components and activities of a sound corporate governance framework are:

(a) Promoting and ensuring adherence to a code of conduct and values;
(b) Risk management;
(c) Continuity of service;
(d) Occupational health and safety;
(e) Ongoing development of staff competencies;
(f) Providing timely and accurate reports to senior/executive management;
(g) A published Service Charter that sets out the standards of service to the community;
(h) Contributing to the organization's annual reports;
(i) Contributing to the strategic and operational planning process.

2.4.4 An ISO 9001 QMS provides an excellent management tool to measure the ongoing performance of the corporate governance activities of an organization. Four key sections of ISO 9001 enable the requirements articulated within them to be aligned with key corporate governance functions. By adopting such a QMS, an NMHS will be able to measure the success or otherwise of its corporate governance activities. Figure 1 below illustrates the alignment of key clauses of ISO 9001 with corporate governance functions, and its value as a management tool.

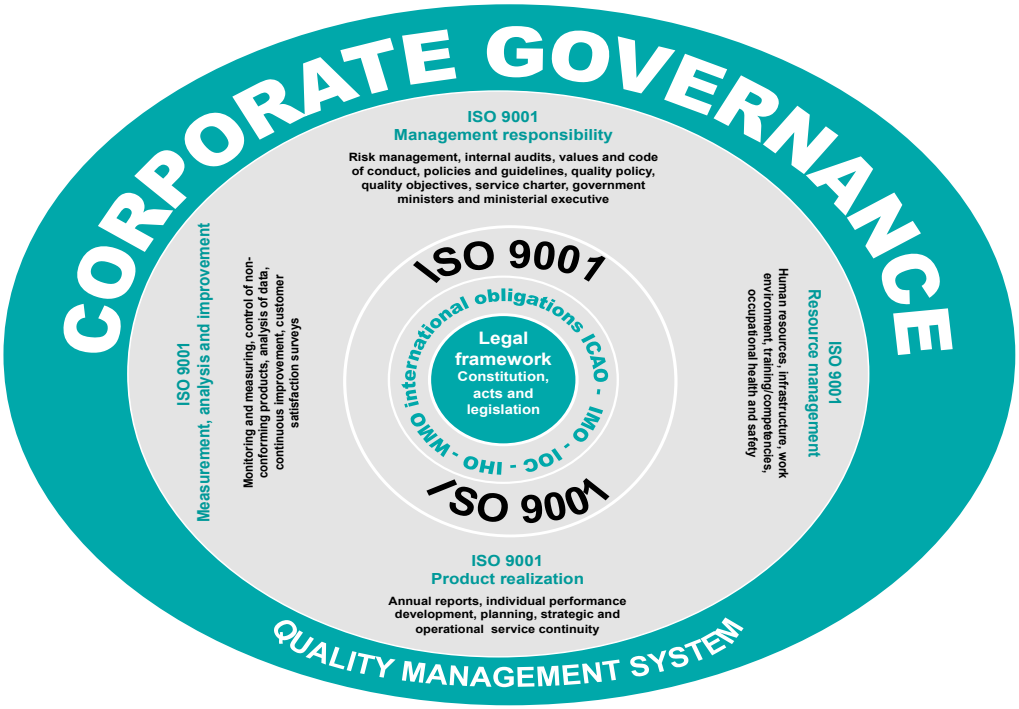


Figure 1. Alignment of corporate governance functions and the requirements of ISO 9001

2.5 ISO 9001 certification and registration

2.5.1 The International Organization for Standardization notes that certification refers to the issuing of written assurance (the certificate) by an independent external body that it has audited a management system and verified that it conforms to the requirements specified in the Standard. Registration means that the auditing body records the certification in its client register. Thus, the management system of the organization has been both certified and registered. The difference between the two terms is not significant and both are acceptable for general use. Certification is the term most widely used worldwide, although registration is often preferred in North America, and the two are used interchangeably. The term accreditation, instead, should never be used as an alternative for either certification or registration because it has a different meaning. Accreditation refers to the formal recognition by a specialized body – an accreditation body – that a certification body is competent to carry out ISO 9001-2008 in specified business sectors. To put it simply, accreditation is like certification of the certification body. Certificates issued by accredited certification bodies may be perceived on the market as having more credibility.

2.5.2 According to ISO, the certification process is expected to provide confidence that the organization has a quality management system that conforms to the applicable requirements of ISO 9001. In particular, it is expected that the organization:

(a) Has established a quality management system that is suitable for its products and processes, and appropriate for its certification scope;
(b) Analyses and understands customer needs and expectations, as well as the relevant statutory and regulatory requirements related to its products;
(c) Ensures that product characteristics have been specified in order to meet customers' and statutory/regulatory requirements;
(d) Has determined and manages the processes needed to achieve the expected outcomes (conforming products and enhanced customer satisfaction);
(e) Has ensured the availability of resources necessary to support the operation and monitoring of these processes;
(f) Monitors and controls the defined product characteristics;

(g) Aims to prevent non-conformity and has systematic improvement processes in place to:
   i. Correct any occurrences of non-conformity (including product non-conformity detected after delivery);
   ii. Analyse the cause of non-conformity and take corrective action to avoid its recurrence;
   iii. Address customers' complaints;

(h) Has established an effective internal audit and management review process, and is monitoring, measuring and continually improving the effectiveness of its quality management system.

2.6 What ISO 9001 certification does not mean

ISO 9001 defines the requirements for an organization's quality management system, not for its products. Certification of compliance with ISO 9001 is meant to instil confidence in the organization's ability to consistently provide products that meet customers' and applicable statutory and regulatory requirements. It is important to note that it does not necessarily mean that the organization will always achieve 100% product conformity.

2.7 Benefits of ISO 9001 certification

2.7.1 The benefits of implementing a QMS and achieving certification of compliance with ISO 9001 are significant. It can be demonstrated that the benefits to an NMHS far outweigh the initial effort and resources required to develop and implement a QMS. Below are some key benefits enjoyed by organizations with mature QMSs. Please note that they are not listed in order of priority:

(a) Customers' needs identified, met and monitored within a consistent management framework;
(b) Improved management control and reporting;
(c) A continuous improvement culture embedded in the organization;
(d) Clear processes in place to address poor quality products;
(e) Enhanced awareness of quality in the organization;
(f) Marketing tool for promoting the organization. This is very important even in the public sector, where it can be difficult to obtain resources;
(g) External audit by a third party. This is a powerful tool to establish credibility and accountability;
(h) Well defined procedures and processes: employees know what to do and how to do it; they don't waste time duplicating efforts;
(i) Enhanced teamwork and communication within the organization;
(j) Clearer job specifications;
(k) Improved occupational health and safety practices;
(l) Customers are assured that they are being provided with quality products and services;
(m) The organization stands out from their competitors;
(n) Customers are reassured that the organization considers their needs and expectations;
(o) Follow-up on complaints to rectify a situation and ensure that customers' needs are met;
(p) The organization functions in a disciplined way as a result of the systematic approach to the handling of its activities;
(q) Fewer problems related to failures in service or product quality;
(r) As the quality management matures, more time spent on improving rather than fixing and reacting to the demands of dissatisfied customers;
(s) Significant decrease in time and money spent on recurring problems as many are resolved permanently;
(t) The organization builds the inner resources and skills to identify and resolve problems more expediently;
(u) The quality manual shows clearly how the organization operates and is a valuable induction tool for new staff;

(v) Significantly improved documentation procedures;
(w) Competencies are gained and maintained through appropriate training;
(x) Corporate knowledge captured as staff retire;
(y) Job satisfaction of employees significantly improved;
(z) The QMS is a powerful tool to ensure important issues are highlighted at the appropriate organizational level.

2.7.2 The adoption of a quality management approach and certification of compliance with ISO 9001 can deliver a vast range of benefits but it should also be remembered that ISO 9001 certification is not an end in itself. It is an important component of the overall continuous improvement process and quality journey of an organization.

2.8 Standards and publications of the International Organization for Standardization

2.8.1 It is essential that all NMHSs adopting a quality management approach to the delivery of their products purchase copies of *ISO 9000:2005, Quality management systems – Fundamentals and vocabulary*, and *ISO 9001:2008, Quality management systems – Requirements.* They may be purchased online, as PDF documents, from the ISO Store.

Note: Since the Standards are updated at regular intervals, please look for the latest edition.

2.8.2 For information pertaining to how ISO develops standards, please refer to the ISO Website (http://www.iso.org/iso/home/standards_development.htm).

KEY POINTS

1. The ISO 9000 family of standards, in particular ISO 9001, is important because of its international orientation. It has the support of national standards bodies from more than 150 countries.
2. ISO 9001 can be applied to all types of organizations in both the public and private sectors, regardless of size or industry group. It can help both product- and service- oriented organizations achieve standards of quality that are recognized and respected throughout the world.
3. ISO 9001 provides an excellent management tool to measure the ongoing performance and success of the corporate governance activities of an organization.
4. It is essential that copies of *ISO 9000:2005, Quality management systems – Fundamentals and vocabulary,* and *ISO 9001:2008, Quality management systems – Requirements* be obtained.
5. There are significant benefits to be gained throughout the organization from the adoption of a quality management approach and the certification of compliance with ISO 9001.

CHAPTER 3. THE EIGHT PRINCIPLES OF QUALITY MANAGEMENT

3.1 Overview

Eight principles of quality management underpin the ISO 9000 Standards and need to be embedded in the QMS to provide a sound foundation for achieving the goals and objectives of the NMHSs. These principles are derived from the collective experience and knowledge of the international experts who participate in the ISO Technical Committee responsible for developing and maintaining the ISO 9000 Standards. The eight principles are articulated below in terms of the activities of an NMHS.

3.2 The eight principles

Customer-focused organization. The very relevance of an NMHS depends on its customers; it must, therefore, understand and meet their needs. The NMHS should establish a sound working relationship with relevant community sectors through formal working groups and regular meetings. Strategies such as these will provide a clear understanding and appreciation of the needs and expectations of customers, the impact of specific products and the environment in which they operate. Ideally an NMHS will not only meet its customers' expectations but will actually exceed them.

Leadership. Sound leadership is fundamental to the success of an organization. The NMHS leadership should establish a vision or a desired future for the organization. It should clearly demonstrate in practice an ongoing commitment to the QMS and create an environment that encourages people to achieve the objectives of the NMHS.

Involvement of people. An NMHS relies on its staff and should ensure that they are adequately involved in the delivery of its products. However, in order to ensure the quality of its products, it should equip its staff with the appropriate skills and knowledge and provide them with ongoing professional development opportunities.

Process approach. An NMHS will be more efficient and effective when it uses a process approach to the delivery of its products. The processes should provide clearly defined accuracy standards and structured formats for all products and services. This enables the efficient management of resources and activities for the delivery of products and services.

System approach to management. The NMHS is advised to use a system approach, which requires the identification, understanding and management of interrelated processes. This could start, for example, with the collection of basic observations and the systematic integration of appropriate information and data via various interrelated processes up to the provision of a suite of forecast and warning products. The system approach to management is critical to the delivery of high-quality NMHS products.

Continual improvement. This should be an ongoing objective of all NMHSs, which is achieved through the application of all the principles. The International Organization for Standardization has emphasized that a key approach to continual improvement entails the development of a close working relationship with the customers of an organization combined with an ongoing commitment to continually improve its overall performance.

Factual approach to decision-making. An NMHS will perform better when it makes an informed decision based on facts. It should measure and evaluate its products, processes and performance. Analysis of this data/information will enable informed decision-making and improvement in service delivery.

Mutually beneficial supplier relationships. The NMHS has a number of mutually beneficial relationships with internal and external customers, partners, specific community sectors, international and national organizations and the various levels of government. These relationships should be appropriately managed and nurtured to ensure benefits to the NMHS.

KEY POINT

It is important that an NMHS ensures that these eight principles form the foundation of its quality management approach to the delivery of its products and services. They should be woven into the processes, outcomes and overall culture of the NMHS.

CHAPTER 4. THE STRUCTURE OF ISO 9001

4.1 General

4.1.1 This section provides insight into the broad intent of each clause and greater clarity for the reader. However, reference must be made to the actual clauses in ISO 9001 Standard, as the following explanations are not a substitute for it.

4.1.2 ISO 9001 defines a set of quality management requirements in parts 4, 5, 6, 7 and 8. These requirements will depend on many factors including the size and structure of the NMHS, its operating environment, objectives, available resources, products and services, and organizational processes. The size and complexity of a QMS and how the requirements are met will vary from one NMHS to another.

4.1.3 The strong attraction of ISO 9001 is that it is designed for third-party certification purposes. When an NMHS deems that its QMS meets the ISO 9001 requirements and the organization's needs, it can appoint an independent certification body (third party) to audit its QMS. If the audit demonstrates that the ISO requirements are met, the NMHS will be issued with an official certificate of approval.

4.1.4 It should be noted that WMO does not currently require that the quality management system of an NMHS be certified. However, national legislation, stakeholder or partner organizations may require certification of compliance with ISO 9001 for some or all of the NMHS activities, particularly in the case of NMHSs providing aeronautical meteorological services. It should be borne in mind that any claim of compliance with ISO 9001 would only attain international credibility if an independent certification body can substantiate that claim.

4.2 The ISO 9001 clauses

4.2.1 The first three clauses are introductory and set the stage for the requirements. The "shall" clauses, which signify the actual requirements, are Clauses 4 to 8. Clause 4 provides an overview of the four major groups of processes within a process-based QMS, which are addressed in greater detail in Clauses 5 to 8 under the following headings:

Clause 5. Management responsibility
Clause 6. Resource management
Clause 7. Product realization
Clause 8. Measurement, analysis and improvement.

4.2.2 The Plan-Do-Check-Act (PDCA) cycle is an iterative four-step management process typically used in organizations that implement quality management. It can be used to coordinate the efforts of an NMHS to continually improve its work processes. It emphasizes and demonstrates that improvement programmes must start with careful planning, must result in effective action and must move on again to careful planning in a continuous cycle. Figure 2 below clearly illustrate this process:

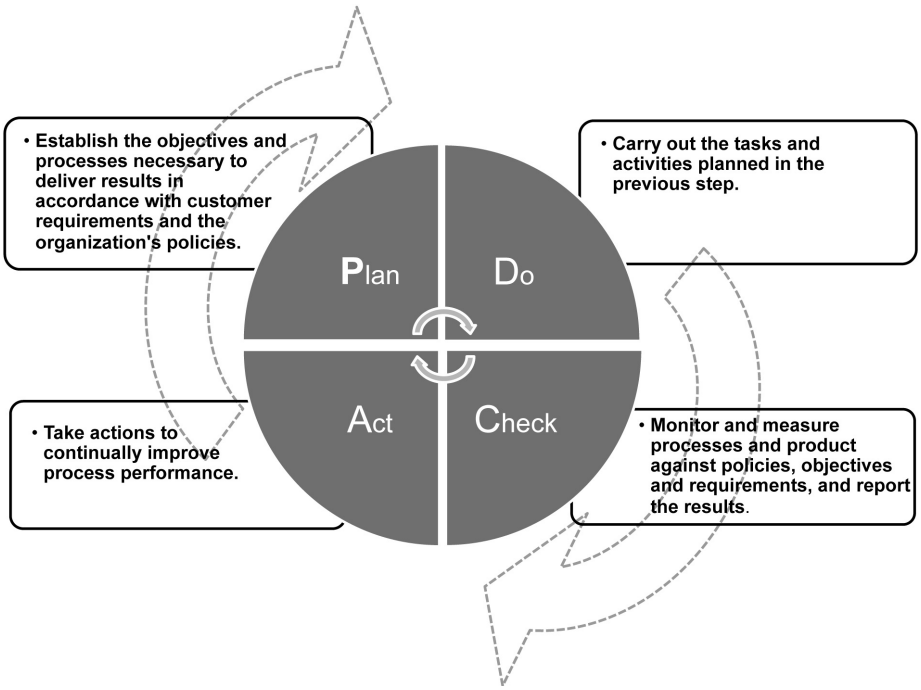


Figure 2. PDCA diagram

4.3 Explanatory notes on the clauses

The following table provides explanatory notes and insights as to the intent of ISO 9001 on a clause-by-clause basis. The user should read this section in conjunction with ISO 9001 to fully understand and appreciate each clause.

Note: Only the clause reference number is provided, not the actual clause.

Clause 1 – Scope	
Requirements	*Guidance notes*
Please refer to ISO 9001	This clause focuses on enhancing customer satisfaction through the effective application of the quality management system, continual improvement of the system and the assurance of conformity to customers' requirements and applicable regulations. When a requirement cannot be applied owing to the nature of the organization and its products, this can be considered for exclusion. Exclusions are limited to requirements within Clause 7, and they must not affect the ability or responsibility of the organization to provide products that meet both customers' and applicable regulatory requirements.
Clause 2 – Normative references	
Requirements	*Guidance notes*
Please refer to ISO 9001	A normative reference specifies a document that must be read to fully understand or implement the subject matter. *ISO 9000:2005, Quality management systems — Fundamentals and vocabulary* is indispensable for the application of this Standard.
Clause 3 – Terms and definitions	
Requirements	*Guidance notes*
Please refer to ISO 9001	As per Clause 2, the primary source for all terms and definitions is *ISO 9000:2005, Quality management systems — Fundamentals and vocabulary.* It should be noted that throughout the text of ISO 9001, wherever the term "product" occurs, it can also mean "service".

Clause 4 – Quality management system	
Requirements	*Guidance notes*
4.1 General requirements	The requirements begin here at a very high level. There are several requirements for the overall QMS rather than individual specific requirements, which will be discussed later. Points (a) and (b) of this part of the clause can be covered by developing a diagram of the organization's process flows from start to finish. Points (c) to (f) are covered in detail within other clauses in the Standard. There is a requirement at the end of this section that addresses the question of control over outsourced processes. Examples of activities that an NMHS may outsource are training, maintenance, observations, and information technology. If the NMHS outsources processes that will directly affect its customers, it should ensure that means of control such as specifications, contracts, procedures and monitoring of compliance are in place.
4.2 Documentation requirements	ISO 9001 specifically requires an organization to have, as a minimum, documented procedures for activities under the following six subclauses: - Clause 4.2.3 Control of documents - Clause 4.2.4 Control of records - Clause 8.2.2 Internal audit - Clause 8.3 Control of non-conforming products - Clause 8.5.2 Corrective action - Clause 8.5.3 Preventive action These documented procedures have to comply with the requirements of subclause 4.2.3. Some organizations may find it convenient to combine the procedures for several activities into a single documented procedure (for example, corrective and preventive action). Others may choose to document a given activity by using more than one documented procedure. Both are acceptable. Some NMHSs, particularly larger ones or those with more complex processes, may require additional documented procedures, such as those relating to product realization processes, in order to implement an effective QMS. Some NMHSs may require additional procedures but the size and/or culture of the organization could enable these to be effectively implemented without necessarily being documented. However, in order to demonstrate compliance with ISO 9001, the organization has to be able to provide objective evidence (not necessarily documented) that its QMS has been effectively implemented. A comprehensive list of documents needed by the NMHS to ensure the effective planning, operation and control of its processes should be established. In order for an NMHS to demonstrate the effective implementation of its QMS, it may be necessary to develop documents other than documented procedures. It should also be noted that there are several requirements of ISO 9001 where an NMHS could add value to its QMS and demonstrate conformity by preparing other documents, even though the Standard does not specifically require them. Examples may include: - Process maps, process flow charts and/or process descriptions - Organization charts - Specifications - Work and/or test instructions - Documents containing internal communications - Test and inspection plans - Quality plans All such documents must comply with the requirements of subclause 4.2.3 and/or 4.2.4, as applicable.

4.2.2	Quality manual	It is now common for organizations to publish information about their QMS on an intranet site thereby meeting the standard requirement for a quality manual. Most organizations have a range of external obligations that have to be satisfied and a trend is developing whereby organizations are including information about occupational health and safety and other compliance systems in their quality manual. The minimum requirement for ISO 9001 is that the quality manual contains: - The scope of the quality system: a brief description of the processes included in the organization's QMS; - Details of and justification for any exclusions: a brief description of any requirement within Clause 7 of the Standard that is not relevant to the NMHS. For example, an NMHS may exclude subclause 7.3 because design and development is not part of its activities; - Procedures: all procedures should be included in the manual or, if they are too many, there should be an indication of where they may be found (for example, on an internal Operations Website). - Interaction of processes: similar to the system model shown in the Standard, the manual should provide a description of how the workflow processes and/or systems interrelate with each other. This could be a map or flow chart that shows all the steps in the process, from responding to a request for a forecast product from a customer to its delivery via a Website or e-mail. It should also contain references to document titles and/or numbers. In developing a quality manual, one should look at it from the perspective of a new employee who would use it as an induction tool. It should provide them with a clear picture of how the NMHS operates and of the processes associated with achieving its outcomes. Although there is no requirement to closely align the information contained in the manual with the Standard clauses, following the numbering of the Standard may be useful. Sample quality management manuals have been posted on the WMO Quality Management web page (http://www.bom.gov.au/wmo/quality_management.shtml). The quality manual can also contain additional information on the NMHS such as policy, customer service, future strategies, past history, organizational structure and charts as required. This document should be easy to read and understand and should reflect the values that the organization wishes to convey to the reader.
4.2.3	Control of documents	The Standard requires the organization to have a procedure that describes its document control requirements. This procedure should help answer the following questions: (a) *How does the organization authorize and approve documents that staff must follow?* It may use an authorizing signature or a password if the documents are available electronically. If the documents in question are externally authored, then a signature of approval is often inappropriate. In this case it may be necessary to draw a list of all currently used externally authored documents that are either signed off or password protected. (b) *How can the organization ensure that documents are reviewed and/or updated as necessary?* It may be helpful to use the internal audits to systematically review the documents in the organization's system. An expiry date in the footer is often a simple way to force a review of internally generated documents such as policies, procedures, etc.

	(c) *How should a change be flagged to the reader? How do people know that they are reading the correct version?* The Standard requires the QMS to ensure that the current document is used at all times, especially in an operational forecast and warning environment. A simple solution is to use the date, just like a daily newspaper, and have a master list of all current documents for reference. Changes can be communicated through a minute in a meeting, a notice on the notice board, an e-mail and so on. Careful thought in this area is required to ensure that simple methods are used. (d) *How accessible is the system documentation?* The intent here is to ensure that staff know where to find the documents they need (not necessarily the complete document suite). If the organization has a paper-based system, one should make sure that only a minimum number of copies are distributed. This helps when changes are required. (e) *Are the organization's documents easy to read?* Is the style appropriate for the reader? Do staff know how to navigate their way through the documentation? Can they readily find the document that is required? Once again, the use of computer-based systems is gaining popularity as common practice for storing and archiving QMS documentation. This allows staff to readily identify and locate relevant documents. (f) *How are externally generated documents managed?* All NMHSs refer to external documents such as regulatory and statutory requirements, official acts and Websites. They are often referenced within their own system documents. Where can they be found? Some NMHSs have a library where such documents are housed; others will designate staff responsible for maintaining them. The organization should also specify a method to ensure that the relevant document is the appropriate issue or version. (g) *What happens to obsolete documents?* If they are no longer needed, they should be disposed of. However, if old documents are kept, precautions should be taken so that staff do not refer to them in error.
4.2.4 Control of records	As with control of documents, a procedure is required that clearly articulates how to control records generated by the NMHS. Records provide evidence of prior events and are referred to when there is a need to recall outcomes of these events. Examples are: forecasts and warnings records, climate records, meteorological observations, training records, financial transactions, inspections, customer agreements, contracts, purchase orders, audit records, accident/injury reports, maintenance records, etc. All records kept should be properly archived. The identified procedure should deal with the following: (a) Identification: are records readily identifiable? Does the filing system allow records to be identified easily? (b) Storage: one should ensure that storage methods prevent damage and/or deterioration. Are electronic storage devices separated from magnetic sources? Are sensitive records maintained in accordance with confidentiality and privacy requirements? (c) Protection: are electronic records protected from easy erasure? Does the archiving system prevent deterioration? Are regular backups performed for electronic records? Are backup systems validated regularly? (d) Retrieval: can records be accessed when required? Is the hardware/software adequately maintained to allow access to old electronic records?

KEY POINTS

1. Although there is no current requirement for an NMHS to undergo certification of compliance with ISO 9001, international credibility can only be attained if an independent certification body can substantiate the claim to compliance with the Standard.
2. Documentation should be simple and relevant to the key activities of an NMHS.
3. The NMHS should ensure that there are documented procedures for the six subclauses specified by ISO.
4. The quality manual must meet the minimum requirements articulated in ISO 9001.
5. The quality manual should be developed and used as a valuable induction tool for new staff to help them gain a clear understanding of how the NMHS operates.
6. Special care should be taken in designing the layout of the quality manual which should clearly explain how to deal with the requirements of each clause.
7. The simpler the method used for document control, the easier it will be to maintain the system. ISO 9001 does not specify how this should be done. It is up to each NMHS to determine its own method for document control.
8. Care should be taken not to create unnecessary paperwork. One should create only those documents that are needed to provide adequate guidance to prevent mistakes. Documents may be controlled by using an issue/version number plus the date. Alternatively, documents could be kept in softcopy format with password protection.
9. A procedure is required that clearly articulates how to control records generated by the NMHS. It should be borne in mind that records provide evidence of prior events and are referred to when there is a need to recall outcomes of these events.

Clause 5 – Management responsibility	
Requirements	*Guidance notes*
5.1 Management commitment	This clause requires that management clearly demonstrate its commitment to the QMS in a practical manner. This will involve performing the following tasks: - Ensuring the provision of the necessary resources; - Promoting quality management and implementing the QMS at all levels of the NMHS; - Defining an authorizing policy and establishing organizational objectives; - Chairing quality management review meetings.
5.2 Customer focus	Management should ensure that the QMS is designed to guarantee the satisfaction of customers and other key stakeholders with the services provided by the NMHS. Management should carefully identify customers' requirements prior to attempting to meet their needs: a common problem is making assumptions as to what the customers need. The customer's level of satisfaction after delivery of a product should also be established.
5.3 Quality policy	The Standard requires that management publish a quality policy. This is a powerful statement of intent by the top management that should be clearly communicated, highly visible and signed off by the Director/CEO. In some NMHSs a customer charter, a mission and/or vision statement may be used to meet this requirement. Care should be taken when documenting a quality policy to ensure that any stated imperatives can be fulfilled, and the expected outcomes are measurable, meaningful and relevant to the NMHS. It is important to ensure that the policy is realistic and contains achievable goals.

5.4 5.4.1	Planning Quality objectives	Objectives should be directly related to how quality will be achieved. They should be measurable goals or targets with related key performance indicators. These are agreed quantifiable measurements that reflect the critical success factors of the NMHS. Objectives should be established at different levels and for different functions within the NMHS. It is advisable to define objectives for each unit, site or department of the NMHS. Care should be taken in establishing short- and long-term objectives that are meaningful, realistic, achievable and measurable rather than high-level static objectives that may not relate to the NMHS area of responsibility. This requirement can be a little confusing as it could appear that there are two types or sets of objectives: those that are developed as part of the normal planning processes and the quality objectives, which could imply that other objectives are not quality or perhaps non-quality objectives. However, this is not the case. All objectives are or should be quality objectives that guide the NMHS towards its overall goals and desired future. It is, therefore, important to ensure that all objectives are measureable and consistent with the quality policy.
5.4.2	Quality management system planning	An NMHS in the process of establishing a QMS should ensure that it meets the requirements of subclause 4.1. This section deals with identifying processes, interaction of processes and criteria for control. It also covers the control of outsourced processes. If an NMHS with an existing QMS finds that new or extra processes have been identified or outsourced, it should ensure that these changes are reflected, whilst maintaining the integrity of the QMS.
5.5 5.5.1	Responsibility, authority and communication Responsibility and authority	Top management should ensure that responsibilities and authority are defined and communicated within the organization. A large proportion of avoidable errors and waste in an organization occur because employees are not clear as to what they are responsible for and what decisions-making power they have. Responsibilities and authority of each employee should be clearly defined and made known to all. It is highly desirable for an NMHS to provide duty statements and/or job/position descriptions that clearly articulate responsibilities. An organizational chart is an excellent tool for illustrating reporting lines within an NMHS. If it is decided to include responsibilities and authority within procedures, care must be taken to ensure that they do not contradict the content of the job/position descriptions.
5.5.2	Management representative	This clause requires that a person with management authority ensures that the QMS is maintained and promoted throughout the organization. This person could be designated as quality manager or given a similar title. It is strongly recommended that the quality manager be a senior member of staff within the NMHS. Care should be taken to ensure that the post description clearly reflects his/her responsibilities. Furthermore, the quality manager should be the “champion” of quality management, which means that he/she should make sure that the QMS is running smoothly and inform top management of its overall performance. Section 5.3 of this Guide addresses in greater detail the importance of this role and of selecting the appropriate person for the position. Appendix 5 provides a sample job description for those NMHSs that are envisaging the establishment of a quality manager position.
5.5.3	Internal communication	Lack of effective internal communication is a recognized major problem for organizations. Clear communication lines should be formally established, documented and recognized within the NMHS to assist in the development of good communication, to promote strong teamwork ethic and to avoid confusion and ambiguity.

5.6	Management review	This requirement ensures that management takes time to focus on the efficiency and effectiveness of the QMS within a structured framework. It provides an opportunity to analyse the information and data pertaining to the performance of the system. This information includes audit results, customer feedback, proposed improvements, changes, complaints, and training issues, or addresses any other areas of concern. As an outcome of this process, actions should be minuted and followed up at the next review meeting. Top management should be involved in this process; it is highly desirable that the meeting be chaired by a senior member of the top management. The frequency of such reviews is determined by the maturity and complexity of the QMS. It is recommended that at least quarterly reviews be carried out during the initial development and implementation of the QMS. This frequency provides an excellent tool for establishing and monitoring the health of the organization. Once the QMS has matured, the NMHS may decide to change the frequency of these review meetings to at least once or twice a year. Appendix 10 provides a generic template for the agenda/minutes of a quality management review meeting.

KEY POINTS

1. National Meteorological and Hydrological Services should ensure that the responsibilities and authority of each employee are clearly defined in duty statements and/or job/position descriptions.
2. The objectives of an NMHS should be realistic, achievable and appropriately resourced.

Clause 6 – Resource management		
Requirements		*Guidance notes*
6.1	Provision of resources	Resource is used as a general term in the context of the ISO Standard and may relate to finances, materials, staff and other assets required by the NMHS to function, attain its objectives and deliver its products and services. In accordance with ISO 9001, an NMHS should determine and provide the resources needed to maintain and continually improve the effectiveness of the QMS to meet customer requirements. The community is increasingly demanding that organizations manage their financial activities diligently, transparently and ethically, and be held accountable for them. It is difficult, if not impossible, from the NMHS perspective, to see how it could provide quality outputs without due regard for the provision of appropriate financial resources. Often, however, there is a conflict between those who are responsible for providing a quality output and those in charge of the allocation of financial support. However, ISO 9001 with its integrated management components provides a framework for well documented, sound management practices. This provides the NMHS with an opportunity to clearly demonstrate its need for the appropriate allocation of both human and financial resources. This management principle in turn boosts the credibility of the NMHS if it has achieved certification of compliance with ISO 9001. Although ISO 9001 does not specifically focus on financial management, it clearly makes sense to include it in the QMS.

6.2 6.2.1	Human resources General	In this part of the Standard the word "competent" has raised a few concerns because of its use in the vocational education sector. The subjective nature of this word means that there is a need to define the competencies required of NMHS employees that relate directly to their workplace environment. These competencies could be presented in the form of a skill matrix, training record, certificate, or they may be defined within individual post descriptions. **Note:** Competence standards of meteorological personnel have been articulated by WMO and included in the latest revision of WMO 49, Vol. I available at ftp://ftp.wmo.int/Documents/MediaPublic/Publications/Technical_Regulation_WMO_No_49/49_Volume_I/49-Vol-I_en.pdf
6.2.2	Competence, training and awareness	Once the competencies have been defined, steps should be taken to rectify any deficiencies/shortcomings identified for new or existing employees. In order to verify whether the actions taken have been successful, an evaluation will have to be undertaken to determine that the competencies have been achieved. Methods that could be used to determine the achievement of the necessary competencies include an examination, a test or simply observation by a supervisor whilst the task is being performed. Such task may consist in producing a forecast or warning in a real-time operational environment, or in a fault finding procedure applied to an instrument specific to the task in hand. The competency assessment toolkit of the WMO Aeronautical Meteorology Programme is a valuable resource which can help meet the requirements of this clause. The toolkit is available at http://forum.14.caem.wmo.int/post14web/tt_cat/ There is also a requirement that employees understand how their work contributes to the overall attainment of the NMHS objectives. This may be achieved through an induction or awareness training session or as part of regular update meetings. Records have to be maintained to prove that training has taken place. Evidence of this could be a certificate from an external provider or a sign-off on an employee's record.
6.3 and 6.4	Infrastructure and work environment	One way of determining what is required under the clause is to establish what policies and/or procedures are needed (or are already in place) to ensure that the required infrastructure and work environment to support the NMHS and its activities are maintained. These can include, but are not restricted to, information technology backup, steps to prevent phone/email/internet server dropouts, building maintenance, pest control, adequate power/gas/water supply, software upgrades, air/dust/temperature control, ergonomic changes in the workplace, etc. Once the infrastructure and work environment required to support NMHS activities, policies and procedures have been identified, they should be formally documented as part of the QMS.

KEY POINTS

1. The application of this requirement will vary according to the products and level of service of the NMHS.
2. The certification of compliance with ISO 9001 and the QMS should be used as a "marketing tool" to strengthen the credibility of the NMHS budget allocations vis-à-vis those responsible for providing financial support.

Clause 7 – Product realization	
Requirements	*Guidance notes*
7.1 Planning of product realization	This section provides the opportunity to reflect on the terminology used in ISO 9001. It is difficult to obtain unanimous agreement within international organizations that have a large membership. The International Organization for Standardization, with Members from over 150 countries, is no different. One of its challenges has been to achieve consensus on expressions such as "providing our service", "product manufacture", "adding value", "controlling the business" and so on. However, "product realization" has been agreed to and indicates an amalgamation of all the resources within an organization that are needed in order to produce a product or service that is required by its customers. The term or expression used must convey what the NMHS does and how all facets of its activities are controlled. Product realization is a somewhat elaborate term used to describe how an NMHS brings to completion/fruition the delivery of its suite of products. It begins with planning followed by understanding and agreeing to customer requirements, design, purchasing, control and validation of processes, identification and care of products, and control of monitoring and measuring devices. Sound planning is a fundamental requirement. The QMS should describe what activities are performed to ensure that adequate planning takes place. This will also ensure the success of an activity without waste of effort. Appendices 1 and 2 to this Guide provide a set of generic planning templates that can be applied to the development of all activities (including products, services and projects) performed by an NMHS. These templates have been used extensively in NMHSs and subjected to numerous rigorous and successful ISO certification audits. The templates enable the NMHS to answer questions such as: What are we trying to achieve? What targets or objectives have been set? What resources will we need? When it's done how are we going to check it and against what? What records will we have to keep? How do we formally accept a new product or service? What follows is important in terms of product realization for those NMHSs that apply for exclusion under Clause 7. It must be remembered that inputs are not just relevant to design and development activities. To achieve product realization for its suite of standard products, the NMHS will still need to utilize the various inputs in compliance with international requirements.
7.2 Customer-related processes 7.2.1 Determination of requirements related to the product	It is imperative that NMHSs clearly identify their key customers and stakeholders. It is important to clearly establish and document the customers' requirements, for example, the number and timing of forecasts to be issued, validity times and whether or not an amendment service will be provided. This will ensure there is no misunderstanding between the NMHS and its customers and internally among NMHS staff. One should also ensure that, if the requirements change, there is an adequate mechanism for communicating these changes. It is acknowledged that establishing product requirements for the general public poses some unique challenges that require innovative approaches by NMHSs. Such approaches may include, for example, Web-based surveys, development of focus groups and feedback from social-networking platforms. It would be very useful for NMHSs to share best practices and exchange views. The WMO Quality Management Network provides an ideal forum for this. It is important that the NMHS understands and appreciates the intended use of the product by the customer(s) and what impact the NMHS product may have on the customer's operations. An approach such as this will focus on those components of the product that will have the highest impact on the customer's operations. However, the objectivity of the process must not be compromised by, for example, trying to accommodate the customer's specific thresholds. Once this has been established, the requirements must be reviewed prior to a formal commitment to supply the product (see also guidance notes under subclause 7.2.2).

	The NMHS should also ensure that any statutory or regulatory requirements that apply to the product are adhered to. These requirements may be national and international. In aeronautical meteorology, for example, there are normally national civil aviation authority regulatory requirements, at the national level, and ICAO requirements at the international level.
7.2.2 Review of requirements related to the product	All reviews and the actions taken thereafter should be appropriately recorded as they provide a valuable resource should a dispute over the product arise at a later date. They are also an excellent source of evidence for audits. After collecting all required information, a decision should be made as to whether the NMHS has the capability to deliver the product. The organization should, for example, check whether it has the appropriate observational, meteorological or hydrological data and information to support the provision of a product. If a product cannot be delivered, the NMHS should, wherever possible, provide the customer with a viable alternative. To avoid internal conflict, a specific procedure should be established to show that the NMHS capability has been assessed. This could be a sign-off by a senior member of the NMHS, or a formal contract signed by all parties. The procedure must also include safeguards so that when an order or contract is received it still reflects what was proposed initially and any agreed changes. **Note:** For verbal orders, a confirmation procedure must be agreed with customers.
7.2.3 Customer communication	Each NMHS should ensure that effective customer communication mechanisms are in place. A major problem in some organizations is that they fail to simply talk to their customers to attain a sound understanding of their needs. Staff of National Meteorological and Hydrological Services should not assume that they know a priori what their customers need, as this can lead to significant problems. Regular industry forums and major public fairs, events and shows (boat, air and agricultural shows) provide excellent opportunities to communicate face-to-face with the NMHS customer base. National Meteorological and Hydrological Services should have a mechanism in place that allows customers to lodge their complaints, which will be handled by designated staff with the necessary training and skills in this area.
7.3 Design and development 7.3.1 Planning 7.3.2 Inputs 7.3.3 Outputs 7.3.4 Review 7.3.5 Verification 7.3.6 Validation 7.3.7 Control of changes	As discussed earlier, any requirement under Clause 7 may be considered for exclusion. Design and development is one of the requirements most often excluded. It should be noted, however, that design and development cannot be excluded if they are part of an organization's normal activities. If the NMHS has a standard suite of products and has no plans to design and develop new products, due consideration should be given to excluding this requirement. It should be borne in mind that any exclusion must be declared, with an explanation, in the quality manual. The layout of 7.3 and its components is relatively easy to follow. It should be remembered that organizations are not required to have a separate procedure or process that follows the exact sequence of the Standard, unless the NMHS decides to have one. In order to obtain the desired output, it is advisable to define a detailed procedure for the various steps of the design activities. It is crucial for quality outcomes and long-term success that the design output is correct. Often this is expressed in the form of a drawing, a plan, project specifications, or a sample of the proposed product.

		The Standard begins with design planning (7.3.1) which covers areas such as resources required, design stages, allocation of responsibilities and cross communication within the NMHS to ensure that all aspects are covered, i.e. finances, customers, safety, marketing, regulatory requirements and product characteristics. The next step involves collecting all information on the required input (7.3.2) to enable design and product realization. Information such as surface, upper-air, ocean and space observation data; forecast products such as nowcasting, forecasts based on numerical weather prediction, seasonal forecasts, forecasts and advisories issued by global and regional centres; statutory and regulatory requirements; and data on product usage, performance criteria, efficiency and similar must be collected and analysed to avoid ambiguity or conflict. When completed, the output (7.3.3) of the design process must meet the input criteria including conformity to any necessary safe operating requirements. Throughout the process there should be reviews (7.3.4) to ensure progress and to correct or improve the design where necessary. To check whether the output has fulfilled the input criteria, verification (7.3.5) must take place. This will establish in theory that the design will be successful. **Note on verification:** In the NMHS operational environment verification is traditionally used to ascertain the quality of a forecast and warning product after this has been delivered. However, in the ISO environment, verification of a product occurs prior to delivery and the quality is validated after delivery. Since the verification of forecasts and warnings prior to delivery is not possible, the NMHS should ensure that prescribed procedures for producing the forecast or warning have been followed by the competent staff (see 6.2 of these guidance notes). Validation (7.3.6) follows verification to prove that the design has worked in practice. The greater the risk associated with the product the more extensive this validation should be. If any changes (7.3.7) occur during or after the design process, they must be recorded. If changes occur after product completion, for example after a forecast or warning has already been issued, verification and validation may have to be repeated on the products already in use.
7.4 7.4.1	Purchasing Purchasing process	In all QMSs controls must be in place to ensure that money is not wasted because of poor purchasing decisions. Risk management practices should be followed to ascertain the impact of the purchased product on the final product or service. Any purchase from an internal or external supplier – including products and services provided by other WMO Members at no cost – that has operational implications should be made with due consideration for any international and national regulatory and/or statutory requirements. It may be worth considering approaching suppliers that have established and continue to maintain their own QMSs, preferably with ISO certification. Whatever the controls or techniques used, records must be kept to establish that evaluations have taken place.
7.4.2	Purchasing information	Staff responsible for purchasing orders or for providing information to suppliers must ensure that the information provided is clear and unambiguous to enable the supply of the correct products and services. This may involve a detailed specification or contract, or a simple quotation of a part number.

7.4.3	Verification of purchased products	In brief, the Standard requires that verification take place to ensure that what was purchased has been received. A risk management approach can be used to determine the extent of verification activities required. Such activities may take the form of simple enumeration, a sample provided prior to acceptance, or some detailed inspection process. Whatever the method used, staff must ensure that consistent practices are followed. This verification may occur at the supplier's premises under a contractual arrangement. If this is the case, then the Standard requires that this condition of purchase be included in the purchasing information provided to the supplier.
7.5 7.5.1	Production and service provision Control of production and service provision	This clause focuses on how the work of an NMHS is controlled (7.5.1 and 7.5.2). The ISO Standard requires that an NMHS product or service be generated and delivered in a controlled manner to ensure that whatever is produced or delivered complies with the customer's requirements. The Standard provides an array of control tools from which to choose. These may be an instruction manual, a suite of instructions, a drawing, specifications, a series of photographs, procedures for inspection and testing and so on.
7.5.2	Validation of processes for production and service provision	This clause focuses on how an NMHS should validate the processes it uses (see the note on verification in 7.3).
7.5.3	Identification and traceability	Most NMHSs will meet this requirement without any difficulty. All forecasts and warnings have (or should have) a specific identifier, validity period and a date/time indicating when the product was issued. Some NMHSs have specific identification numbers for each product that is generated, disseminated and electronically archived. This means that they can be clearly identified, traced and retrieved at any given time.
7.5.4	Customer property	If the NMHS uses customer property such as instrumentation, which adds value to the development of a product, it should have specific control mechanisms in place to protect and care for the goods supplied or owned by the customer.
7.5.5	Preservation of products	The NMHS should have controls in place to ensure that any product at whatever stage is protected from damage or corruption up to the point of delivery. This would for example include damage from a software virus that could corrupt a forecast product. Consequently, appropriate virus protection software should be in place.
7.6	Control of monitoring and measuring equipment	Instrumentation or devices that ascertain whether or not a product has met specified requirements must be accurate. Control measures may be formal maintenance schedules or calibration and traceability of equipment in accordance with national or international standards. Whatever the controls in place, the devices used, which can include software testing programs, must be appropriately maintained and identified. There is a range of ISO Standards such as 17123, 17025 and 10012 that are specific to testing and calibrating equipment. These would be of assistance in this area. **Note:** Lists of documentation used by some WMO Programmes have been established and are available on their respective Web pages.

KEY POINTS

1. Sound planning is a fundamental requirement.
2. The NMHS should never undertake or commit to tasks without ensuring it has the capability to deliver. It is essential to make an informed assessment prior to committing.
3. Customers' requirements should be clearly established and documented to ensure that there is no misunderstanding of what is required.
4. If product requirements change, the NMHS should ensure that the appropriate resources to support the changes are in place and that there is a mechanism for communicating these changes to all stakeholders.
5. Validation follows verification to prove that the design has worked in practice. The greater the risk associated with the product the more extensive this validation should be.
6. Whatever the controls or techniques used, records must be kept to establish that evaluations have taken place.
7. Exclusions must be declared in the quality manual and an explanation given for the decision.

Clause 8 – Measurement, analysis and improvement	
Requirements	*Guidance notes*
8.1 General	The effective management of an organization requires that appropriate measures of success be defined and implemented. An NMHS should, therefore, choose appropriate methods and techniques to monitor, measure and analyse its activities in order to determine its success. This is also directly related to the effectiveness and efficiency of its QMS. There must be good monitoring systems in place to produce meaningful information and data that can demonstrate conformity to the Standard and identify where improvements are needed.
8.2 Monitoring and measurement 8.2.1 Customer satisfaction	The fundamental goal of any organization is to satisfy its stakeholders, primarily its customers. Arguably they are the very reason for an organization's existence. Satisfied customers will help to ensure that the NMHS receives the appropriate level of funding. It is important, therefore, to gain a clear understanding of how satisfied they are with the products or services supplied by the NMHS. The ISO Standard does not specify how an organization can gain information on customer satisfaction. It requires, however, the monitoring of information relating to customers' perception of the organization and whether their expectations have been met. The NMHS should determine the best method(s) to do this. Surveys are commonly used for this purpose, but it is essential that the right questions are asked. Retrieving and analysing completed surveys may require considerable effort. Appendix 3 provides a generic template for a customer satisfaction survey, which has been used successfully. Whatever the NMHS decides to use to gauge customer satisfaction, it should ensure that staff are made aware of the methods chosen and that these are applied consistently.

8.2.2	Internal audit	The audit process is the "glue" that holds the QMS together. It is a primary tool that an NMHS can use to ensure that its QMS is kept up to date. Developing and implementing a QMS requires a significant effort. A key aspect of the QMS, from an audit perspective, is procedures. Unfortunately, there are not many volunteers willing to write procedures. However, as these are vital to the QMS and the audit process, they should be pursued. Section 5.7 of this Guide provides guidance in this area. It is strongly recommended that the NMHS selects appropriate techniques and suitable staff to perform internal audits: unsuitable or poorly trained auditors can do significant damage to the NMHS. As the QMS of an organization matures and its practices, procedures and techniques change, so should the QMS. Auditing is a way to ensure that an organization's systems match its processes and that new and improved techniques become normal practice. A good indication that an NMHS has embraced a quality management approach is when employees welcome an internal audit of their activities. Unfortunately, some managers use the audit process as a policing tool rather than an information gathering exercise. This should be identified and rectified as soon as possible. All audits should be conducted in a positive and non-threatening manner, otherwise they will be a waste of time. Audits should help the NMHS improve its QMS and should not be conducted just to fulfil the requirements of the certification process. The ISO Standard does not specify the techniques to be used for conducting an internal audit. Unlike certification audits, internal audits are less formal and should be scheduled according to the NMHS organizational demands, priorities, available resources and risks associated with its operations. To facilitate this process, a procedure should be written down as guidance for all staff, including the internal auditors, to simply explain how the NMHS wishes to conduct internal audits. A generic procedure is presented in Appendix 9 to this Guide for consideration. All facets of the QMS will need to be audited. This can be done stage by stage over several audits. The internal audit does not assess all facets of the QMS at once, but it uses samples of job descriptions, procedures, instructions, policies, plans, organisation charts, flow charts, etc., including the linkages between these documents. Procedures should not be audited individually. Several linked procedures should be audited as a process to ensure that there are neither gaps nor too many overlaps between them. A flexible audit schedule is a critical component of the audit process. Internal audits should be carried out prior to planning and budgeting activities. For example, 1-2 months prior to the development of the annual operational plan, the NMHS should ensure that any significant issues identified during the audit are addressed as part of the planning process. The same applies to the budgeting process. Outcomes of an audit can highlight areas that require an injection of funds to rectify a specific issue. Internal audits should also be planned and carried out prior to external audits. However, they should not be performed only one or two weeks before an external audit just to provide evidence to an auditor. They should be part of the usual activities of the NMHS.

	Internal audits should also be used on an ad hoc basis to highlight a significant issue that may have arisen. The audit will or should be the catalyst to ensure remedial action is taken. The results of audits are tabled at management review meetings (see Section 5.6 of this Guide) and reported to the top management of the NMHS. If the audit process gets "off track" from the established schedule, it is important not to do some hurried audits to get back on track. It is better to select the most important processes and audit them properly, and re-schedule other audits for a later date. Further guidance on the overall auditing process and the selection and training of internal auditors is addressed in section 5.7 of this Guide.
8.2.3 and 8.2.4 Monitoring and measurement of processes and products	It is strongly recommended that the processes and products of the NMHS be monitored and measured. With regard to processes, the NMHS should consider the following questions: - Is the organization maintaining its equipment/instrumentation at an appropriate level? - Is there a documented maintenance schedule in place? - Is the appropriate testing and maintenance equipment available? - Is there an equipment depreciation table/schedule? Records should be kept as evidence of these activities. With regard to products, the NMHS should ensure that appropriate records are maintained to show that the products it has provided conform to requirements prior to delivery. Once again, records should be kept as evidence of these activities.
8.3 Control of non-conforming product	Regardless of how diligent an organization is, often activities do not go according to plan and might result in non-conforming products. It is the responsibility of each NMHS to have control mechanisms in place to ensure that any incorrect product or service is identified and dealt with. The key to this clause is the way in which non-conformities are captured and recorded. It is recommended to keep a nonconformity log or something similar, which can help identify recurrent problems. In a shift-work environment where a number of people occupy the same position this is a vital QMS tool. Internal problems are usually found by the employees as a result of real-time analysis, inspections, maintenance activities or audits, whereas external problems are identified following post-delivery verification or customer feedback. It is strongly recommended to have a procedure that describes how non-conforming products are identified and captured, how they are dealt with, who is responsible for deciding what to do, what action should be taken and what records are to be kept. A generic non-conformity procedure is provided in Appendix 4. Problems should not all be tackled in the same way. There may be a formal process for dealing with a major issue but there should also be another process for tackling minor issues. The management of each work area, in close consultation with its staff, should establish what is to be considered a major or minor problem, on the basis of established risk levels, and should define and document remedial actions.

8.4	Analysis of data	An NMHS should undertake a careful analysis of selected data in an effort to detect trends. This will provide an opportunity to take advantage of positive trends. Conversely, should negative trends be detected, it would be possible to take preventive action. A good example is forecast verification. The Standard states that there are four areas in which data should be analysed to obtain information on the performance and effectiveness of the QMS. Each of these areas will also provide information on the overall organizational health of the NMHS. The result of this analysis should provide valuable input into the management review process.
8.5 8.5.1	Improvement Continual improvement	This clause aims to ensure that the NMHS is making progress with regard to the effectiveness of its QMS. It raises questions such as: Are outputs better this year than they were last year? Are we optimising the use of our resources? Are we making better use of our system indicators such as audits, management review and data analysis? To survive, all organizations must improve over time or face losing their integrity and, with it, their credibility. It makes sense, therefore, to ensure that sound measures are in place to provide this information.
8.5.2	Corrective action	This clause is similar to 8.3 in its intent. Difficulties will inevitably arise and with them the need to identify the problem and solve it. Historically, a number of organizations have developed special forms but this is not always necessary. Moreover, the very need to fill out a form is often a disincentive to solving a minor problem. The ISO Standard requires that appropriate action be taken to address the effects of the problem. This may require a simple correction by the duty officer or, in a major event, significant levels of resources. A risk analysis can help to determine the appropriate actions that need to be taken. The NMHS should, therefore, establish a corrective action procedure that clearly defines what needs to be done to solve or rectify the problem.
8.5.3	Preventive action	Preventive action is a better option as it involves acting before a problem occurs. It can also save considerable time and money. Analysing trends (see subclause 8.4) and taking action prior to the occurrence of a case of non-conformity helps to prevent problems. As with corrective action, the Standard requires a preventive action procedure. Due consideration should be given to combining the preventive and the corrective action procedures thereby simplifying the process. Examples of preventive action are: staff training, maintenance, application of audit results, customer feedback, use of control charts and other statistical techniques.

KEY POINTS

1. A key to a successful QMS is the availability of data to provide objective information as a measure of conformity to policies, objectives, goals and key performance indicators such as customer satisfaction measures.
2. Satisfying its stakeholders, and primarily its customers, is the very reason of an organization's existence.
3. Corrective action is defined as the action taken to eliminate the cause of an identified non-conformity. Preventive action is an action taken to eliminate the cause of a potential non-conformity.
4. Due consideration should be given to combining the preventive and the corrective action procedures thereby simplifying the process.

CHAPTER 5. STEPS FOR IMPLEMENTING A QUALITY MANAGEMENT SYSTEM

5.1 Implementation overview

Figure 3 below presents an overview of the broad steps that need to be taken to develop and implement a QMS. It is assumed that this overview would provide a foundation tool at an initial meeting to discuss whether or not an NMHS will adopt a quality management approach to the delivery of its services. It is not possible to determine exactly how long it takes to implement a QMS and achieve certification of compliance with ISO 9001. Many factors such as the size of the organization, whether or not it is assisted by a consultant, the maturity of the organization's processes and documentation, availability of resources and the commitment of the top management and the staff can affect the time required to implement a QMS. First-hand experience suggests that, with due regard to the above factors, 18–24 months is a realistic and achievable time frame for a small-sized NMHS or specific sections of the NMHS such as aviation weather service. Small sections or units (~20 staff) in an NMHS could implement and achieve certification of compliance with ISO 9001 within 18 months. It is advisable to adopt an incremental approach where a QMS is developed and implemented for different sections or programme areas of the NHMS. Success in these individual areas could raise confidence and staff buy-in leading to the implementation of a QMS in other areas of the NMHS. Figure 4 overleaf presents a timeline that takes into account the 12 basic steps presented in Figure 3 whilst incorporating internal audits and quality management review meetings.

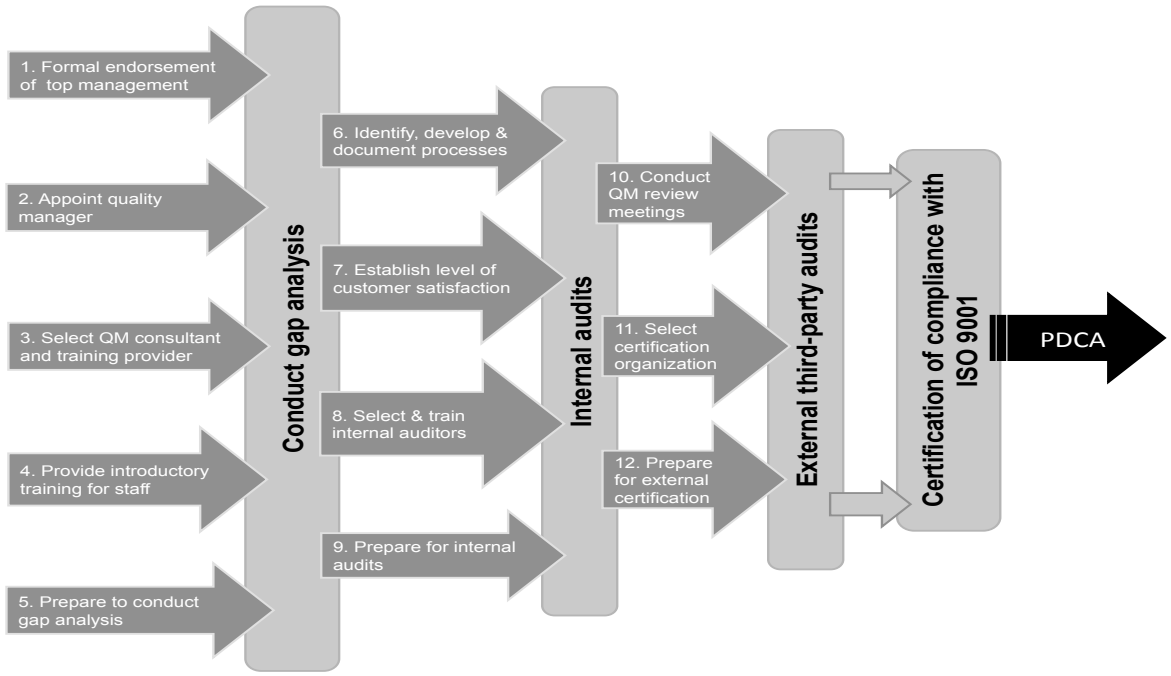


Figure 3. Primary steps to achieve compliance with ISO 9001 and enhance customer satisfaction

	Prior to	MONTH																	
		1	2	3	4	5	6	7	8	9		11	12	13	14	15	16	17	18
Step 1 – Obtain the formal endorsement of top management at the initial quality management planning meeting																			
Step 2 – Select the NMHS quality manager/coordinator																			
Step 3 – Enlist the assistance of an experienced organization or individual																			
Step 4 – Provide introductory ISO 9001 training for staff																			
Step 5 – Conduct a gap analysis																			
Step 6 – Conduct a quality management review meeting to ascertain the current status of implementation																			
Step 7 – Identify the processes and develop procedures as necessary																			
Step 8 – Establish customer statisfaction measures and tools																			
Step 9 – Identify and train appropriate staff to undertake the role of internal auditor																			
Step 10 – Conduct first internal audit																			
Step 11 – Conduct a quality management review meeting																			
Step 12 – Select an organization to perform the ISO compliance certification																			
Step 13 – Conduct second internal audit																			
Setp 14 – Conduct a quality management review meeting																			
Step 15 – Conduct third internal audit if required																			
Step 16 – Conduct a quality management review meeting																			
Step 17 – Prepare for the external audit																			

Figure 4. Broad timeline for the implementation of a QMS and certification of compliance with ISO 9001 for a small section or unit of an NMHS

5.2 Step 1 – Obtaining the formal endorsement of top management

5.2.1 Clause 5.1 of ISO 9001 has already been addressed in Section 4.3 of this Guide. However, the importance of this clause should be emphasized as it is the first step towards adopting a quality management approach to the delivery of NMHS services. Clause 5.1 requires top management to demonstrate its commitment to the development and implementation of a QMS. This demonstration of commitment should also involve a formal endorsement that is communicated to all staff.

5.2.2 Most NMHSs operate within a public sector framework and may not have complete control over their budget. However, the Director/CEO of the NMHS must ensure that the finances to support a quality management initiative will be available. The proposed development and implementation of the QMS should be formally documented and include the proposed implementation strategy, a broad timeline and an estimated budget.

5.2.3 It is not possible within the context of this Guide to indicate the exact cost of implementing a QMS. The scope of the QMS and the costs of training, consultancies and certification bodies will differ from region to region. However, this Guide will point to some important questions concerning the financial commitment required, which will need to be asked at a later stage in this QMS implementation overview. Although the answers to these questions will enable the NMHS to draw a fairly accurate budget, it would also be prudent to set up a contingency fund to cover indirect costs that may not have been identified initially. An NMHS may, for example, decide to upgrade its instrumentation to enhance the quality of its observation network. Additional and at times hidden costs might be involved in obtaining the certification from the manufacturer of the instruments.

5.2.4 Finally, a word of caution regarding this step: unless the formal endorsement and commitment of the top management can be obtained, and the appropriate level of resources secured, trying to implement a QMS might turn out to be a waste of time and resources. The failure of this process would have an adverse impact on staff morale.

5.3 Step 2 – Selecting the quality manager or coordinator for the National Meteorological and Hydrological Service

5.3.1 The appointment of a quality manager or quality coordinator is a key factor in the success of a QMS. It is strongly recommended that a full-time staff member be appointed at a senior level. It is essential that the individual selected is committed to remaining in service during the development, implementation and subsequent phases of the QMS.

5.3.2 The position will inevitably be the driving force behind the QMS and the primary focus for issues pertaining to the QMS. It requires an individual with a specific set of skills, knowledge and character traits that will earn him/her the trust of the NMHS top management and direct access to it.

5.3.3 A generic job description and selection criteria for this key role is provided in Appendix 5, which could be used as a starting point for establishing such a role in the NMHS.

5.3.4 It is essential that the individual appointed has a strong desire for and interest in undertaking the challenges associated with developing and implementing a QMS. A forced or political appointment will potentially, if not inevitably, undermine the QMS and result in its failure.

5.4 Step 3 – Enlisting the assistance of an experienced organization or individual

5.4.1 If the NMHS appoints a quality manager who has no experience in the development and implementation of a QMS but shows great potential, it would be well worth considering seeking the assistance of an NMHS with a mature QMS or a WMO expert in quality management, or hiring a quality management consultant.

5.4.2 It is strongly recommended that several potential candidates (especially consultants) be interviewed to ascertain their knowledge, relevant experience and how well they would align with the NMHS organizational culture. The interview process provides an opportunity to assess their commitment to working with the NMHS. This can be done by ascertaining the level of interest they have shown prior to the interview in obtaining information about the activities of the NMHS and the services it provides.

5.4.3 A number of consultants will also propose a quality management training service and their training credentials should be assessed by carefully checking their qualifications and course content. It is important that they are accredited trainers and can provide an introductory course that will "demystify" ISO 9001 for all staff involved in the QMS.

5.4.4 A basic set of questions for establishing the credentials and the suitability of potential experts is provided in Appendix 6.

5.5 Step 4 – Providing introductory ISO 9001 training for staff

The NMHS should organize an introductory training session for all staff involved in the QMS, starting with the core quality management team and especially the CEO/Director. A basic introductory ISO training course helps to ensure the successful implementation of a QMS by providing a sound understanding of the principles and practices pertaining to ISO 9001. One may be fortunate enough to find a quality management expert/consultant that is also a qualified training officer. Ideally this course should be provided by a registered training organization with expertise in this area. Although not ideal, if a staff member has to conduct the training session, he/she must have a sound and demonstrated background in the subject matter combined with, wherever possible, formal training skills.

5.6 Step 5 – Conducting a gap analysis

5.6.1 A gap analysis is a technique for determining the steps to be taken to move from the current state to a desired future state. In the case of the QMS, a gap analysis is undertaken to clearly identify which clauses of ISO 9001 are currently not being fully applied (or not applied at all) and develop remedial actions. The gap analysis should be conducted by members of the quality management team/section who have auditing qualifications (see Section 5.9 below).

5.6.2 The two gap analysis tools (Part A and Part B) listed below provide a structured framework to assess the current status of an NMHS in terms of fulfilling the ISO 9001 clauses.

Note: The tools are broadly based on the Praxiom Research Group Limited gap analysis tool.

(a) *Part A: Gap analysis* is aligned with the clauses of ISO 9001. A gap analysis template (see Appendix 7 to this Guide) provides comments and notes to assist users.
(b) *Part B: Gap analysis findings* lists the remedial actions that are recommended to close the identified gaps between ISO 9001 and the current management system of an NMHS. A gap analysis findings template (see Appendix 7) provides comments and notes to assist users.

5.6.3 An important consideration in using the gap analysis tools is that for most staff this will be an introduction to an audit-like process and the practical aspects of a QMS. It is, therefore, important that it is a positive experience from all perspectives. Any gap analysis or audit should be focused on the processes and the overall system, not the individuals following the practices and procedures provided.

5.7 Step 6 – Identifying processes and developing procedures

5.7.1 Developing and writing procedures that are currently being followed is a critical component of a QMS. It is imperative that they are developed in close consultation with the staff who follow them as part of their duties.

5.7.2 It is important to find a balance between overdocumenting and not providing sufficient information whilst ensuring that processes are clearly articulated and unambiguous. Further information pertaining to documentation may be found in *ISO 9000 Introduction and Support Package: Guidance on the Documentation Requirements of ISO 9001:2008*, on the following ISO Web page: http://www.iso.org/iso/02_guidance_on_the_documentation_requirements_of_iso_9001_2008..pdf

5.8 Step 7 – Establishing appropriate measures and tools to acquire information on customer satisfaction

5.8.1 It is essential that appropriate client satisfaction measuring tools are established from the outset so as to provide a baseline from which to assess improvement in service delivery. ISO 9001 notes that there are a number of ways in which the level of client satisfaction can be measured.

5.8.2 Industry focus groups can be used as viable measuring tools where the NMHS communicates face-to-face with representatives of a particular industrial sector which it serves. Focus groups are valuable because they provide an opportunity to ask questions, to clarify customers' feedback and to develop strategies with the customer to rectify any problem. Focus groups can also help to establish a core reference group which will gain better knowledge and understanding of the environment in which the NMHS operates. It is important that the actions arising from these meetings and the levels of customer satisfaction thereby identified are fully documented in accordance with the ISO 9001 requirements for record control. The documented outcomes will enable the identification of trends in customer satisfaction over a period of time.

5.8.3 Customer survey tools can enable the NMHS to reach a larger audience. However, it is notoriously difficult to get customers to respond to surveys. It takes a great deal of tenacity and patience to obtain a viable number of responses that provide credible and useable feedback on customer satisfaction. When preparing a customer satisfaction survey, the following broad key points should be borne in mind:

- The reason for conducting the survey, its target group and the most appropriate time to conduct it should be clearly established;
- The contents of the survey should be well organized;
- A budget for the survey (including mail costs where applicable) should be prepared;
- The questionnaire should be well designed and the questions clearly formulated;
- The method that will be used for the survey (email, Web-based, hard copy, telephone, focus group) should be clearly defined;
- The method for analyzing the results should be clearly established;
- The questionnaire should be pretested before finalizing it;
- Dates for dispatching and returning the questionnaire should be set;
- Collecting the questionnaires: this is when tenacity and patience are required of those conducting the survey;
- The data analysis process should be clearly defined and implemented;
- Due care should be taken in interpreting the findings;
- Special attention should be paid to developing the actions needed to address the issues raised;
- A survey report should be disseminated to key stakeholders and most importantly to NMHS staff.

5.8.4 A generic template for a customer satisfaction survey tool is provided in Appendix 3.

5.8.5 A feedback facility on the NMHS Web page can also provide valuable input. It is strongly recommended that the Web feedback page be clearly organized so that survey participants can immediately see what the feedback pertains to. This will maximize the usefulness of the feedback for the NMHS. A generic Web feedback page layout is provided in Appendix 8.

5.9 Step 8 – Identifying and training appropriate staff to undertake the role of internal auditor

5.9.1 It is critical that due care be taken in selecting staff to perform the role of internal auditor. Individuals who show potential as auditors should be given formal training by a registered training organization (see Section 5.4 of this Guide).

5.9.2 Apart from the appropriate training, they should also possess the necessary personal qualities and attitude that enable them to act in accordance with the principles of auditing. *ISO 19011:2011, Guidelines for auditing management systems* lists six principles of auditing:

(a) **Integrity**: the foundation of professionalism

Auditors should:
- Perform their work with honesty, diligence and responsibility;
- Observe the law and make the disclosures required by the law and the profession.

(b) **Fair presentation**: the obligation to report truthfully and accurately

Audit findings, conclusions and reports should reflect truthfully and accurately the audit activities. Significant obstacles encountered during the audit and unresolved diverging opinions between the audit team and the individual being audited should be reported.

(c) **Due professional care**: the application of diligence and judgment in auditing

Auditors should exercise care in accordance with the importance of the task they perform and the trust placed in them by audit clients and other interested parties. Having the necessary competence is an important factor.

(d) **Confidentiality**: integrity and security of information

Auditors should be prudent in the use and protection of the information acquired in the course of their duties. Auditors should not disclose information without appropriate authority unless there is a legal or professional obligation to do so.

(e) **Independence**: the basis for the impartiality of the audit and objectivity of the audit conclusions

Auditors should be independent of the activity being audited and should be free from bias and conflict of interest, wherever practical. Auditors should maintain an objective state of mind throughout the audit process to ensure that the audit findings and conclusions are based only on evidence.

(f) **Evidence-based approach**: the rational method for reaching reliable and reproducible audit conclusions in a systematic audit process

Audit evidence should be verifiable. It will be based on samples of the information available, since an audit is conducted during a finite period of time and with finite resources. The appropriate use of samplings is closely related to the confidence that can be placed in the audit conclusions.

(Adapted from ISO 19011:2011, Guidelines for auditing management systems, pp. 4 and 5)

5.9.3 There are a number of other factors that influence the outcome of an audit. Figure 5 below provides an overview of the key factors leading to high-quality audit outcomes.

5.9.4 It is suggested that the NMHS obtain a copy of ISO 19011:2011 which provides excellent guidelines on auditing a QMS. A copy may be purchased from the ISO online store at http://www.iso.org/iso/publications_and_e-products.htm.

5.10 Step 9 – Conducting internal audits

5.10.1 Conducting an audit and developing a robust internal audit schedule is another critical component of a QMS. As stated in ISO 9001-2008, p. 12:

> 8.2.2 Internal audit
>
> The organization shall conduct internal audits at planned intervals to determine whether the quality management system
>
> a) conforms to the planned arrangements (see 7.1), to the requirements of this international Standard and to the quality management system requirements established by the organization, and
>
> b) is effectively implemented and maintained.
>
> An audit programme shall be planned, taking into consideration the status and importance of the processes and areas to be audited, as well as the results of previous audits. The audit criteria, scope, frequency and methods shall be defined. The selection of auditors and conduct of audits shall ensure the objectivity and impartiality of the audit process. Auditors shall not audit their own work.
>
> A documented procedure shall be established to define the responsibilities and requirements for planning and conducting audits, establishing records and reporting results.
>
> Records of the audits and their results shall be maintained (see 4.2.4).

5.10.2 It is strongly recommended that NMHSs widely publish an audit schedule (plan) as it will be useful as a planning tool for key stakeholders.

5.10.3 The internal audit procedures should cover all facets of preparing for and conducting an audit: audit scope, references, definitions, audit schedule, audit performance, follow-up audits, corrective action, follow-up format, audit documentation, audit failure and management review. A generic internal audit procedure and an internal audit chart summary are provided in Appendix 9 and can be used as a quick reference.

5.10.4 Paragraph 5.9.2 of this Guide addressed in broad terms the qualities required of auditors. However, it is also important to note, as per subclause 8.2.2 of ISO 9001, that auditors must be objective and impartial and "shall not audit their own work". This needs to be addressed from both the internal and external auditor perspective.

5.10.5 The situation can be relatively easily rectified within the NMHS internal audit environment. The quality manager should ensure that internal audits are conducted by staff who do not work in the area being audited.

5.10.6 In the case of external auditors, the need for objectivity and impartiality is even more important. There are many organizations globally offering their services to assist in the development and implementation of a QMS. However, there are some that may also offer their services as the certification body and this is inappropriate since subclause 8.2.2. of ISO 9001 clearly states that "auditors shall not audit their own work". Any NMHS contemplating hiring such an organization should give it considerable thought since the credibility of the NMHS quality management system and its certification of compliance with ISO 9001 depends on the objectivity and impartiality of the third-party external audit process. If the certification body

Figure 5. Key factors for achieving a high-quality outcome

actually helps to develop and implement the QMS and then conducts the third-party audit, it can be neither objective nor impartial and fails to meet the requirements of subclause 8.2.2 of ISO 9001.

5.11 Step 10 – Quality management review meetings

5.11.1 Although there are no specified time periods in ISO 9001, NMHSs are encouraged to conduct quarterly quality management review meetings during the initial development and implementation of the QMS, and subsequently once a year or more often as necessary. Subclause 5.6 of ISO 9001 provides a detailed specification of management reviews of the QMS. Appendix 10 to this Guide provides a generic template that may be used very effectively for the review meeting agenda and minutes.

5.11.2 With regard to the participants in a quality management review meeting, it is highly desirable that a senior member of the top management of the NMHS chairs the meeting. This will show both NMHS staff and auditors that the top management is committed to the QMS. The secretarial duties would nominally be undertaken by the Quality Manager/Section. Senior officers and other staff from the area within the scope of the QMS, as appropriate, and internal auditors could also participate in the review meeting.

5.12 Step 11 – Selecting an organization to perform the ISO compliance certification

5.12.1 Selecting an organization to perform the ISO 9001 compliance certification is an important task. It is essential that the credibility of the certification body, in terms of its experience, relevance, knowledge and values, is established through a formal selection process. When selecting a certification organization, the NMHS should consider the following:

(a) Whether or not it complies with *ISO/IEC 17021:2011, Conformity assessment – Requirements for bodies providing audit and certification of management systems*, and can demonstrate a positive track record in assisting Members' NMHSs in developing and implementing a QMS;

(b) The profile and credibility of its "standard mark" from both a national and international perspective;
(c) Whether it currently provides certification for suppliers of weather services and/or allied industries;
(d) Its commitment to providing strict and thorough audits;
(e) The availability of an audit team member who has a sound understanding and appreciation of the activities, products and services of an NMHS;
(f) Whether it has a definitive fee structure for the three-year certification period including any costs associated with travel;
(g) Obtaining testimonials from current and former clients as to the quality of its services.

5.12.2 To ascertain further credentials pertaining to potential certification bodies, it is highly recommended to consult the Website of the relevant national accreditation organization. This will provide a list of national certification bodies. Access can be obtained through the International Accreditation Forum Website (http://www.iaf.nu/).

5.12.3 Additional information on selecting a certification body may be accessed through the following ISO web page: http://www.iso.org/iso/home/standards/certification.htm

5.13 Step 12 – Preparing for an external audit

Preparing for an ISO 9001 third-party certification audit can be a daunting experience for all concerned. However, here are some guidelines pertaining to this process:
(a) The NMHS should embrace the audit process as a positive experience, which will help improve its processes, systems and the overall quality of its products;
(b) The NMHS should liaise with the certification body to establish dates for the audit that suit all concerned. Most importantly, the organization should not consider undergoing the certification audit unless there is a strong indication – based on the success of internal audits and the advice of the quality management consultant, if there is one – that it will be successful;
(c) All staff should be provided with adequate lead time to prepare for the audit;
(d) The certification auditors should be briefed on any potential safety issues concerning the location they will visit;
(e) All documentation that may be needed during the audit should be easily accessible;
(f) The NMHS should ensure that staff do not attempt to hide or cover up any known problem areas. The certification costs money but it is an investment in the future of the organization and ongoing improvement.

APPENDIX 1. GENERIC PRODUCT/ACTIVITY DEVELOPMENT PLANNING TEMPLATE

Governance

This plan incorporates all the elements for appropriate governance including:

- An outline of the relationships between all internal and external groups involved and a clear assignment of roles and responsibilities;
- A mechanism to assess the compliance of the completed activity with its objectives;
- An agreed specification for the deliverables;
- A defined method of communication with each stakeholder and a system of accurate upward status and progress reporting;
- A process for the recording and communication of risks identified during the activity;
- Required approvals and direction for the activity.

Note: The term "product" is interchangeable with the term "service". In the context of maximizing the use of this planning template, it can also be substituted with the word "project" to cover specific projects that the National Meteorological and Hydrological Service (NMHS) undertakes.

Version Control

VERSION	AUTHOR	DATE	COMMENTS

1. PRODUCT/ACTIVITY			
Product/Activity name			
NMHS programme			
Start/End date			
Stakeholders	List the key stakeholders or stakeholder groups who will be affected by the initiative. Stakeholders provide or receive a service; they are critical to the success of the initiative.		
Related activities	List any related activities that depend on this initiative or on which it depends. They may share data, function, technology or staff with the project.		
Product authority	Detail the lines of authority and responsibility.		
Product funding	Identify the source of funding		

Responsible officers	**Name**	**Position/ Section**	**Phone**	**Email**
Sponsor				
Manager				

2. PRODUCT DESCRIPTION	
NMHS objective	Include broad NMHS objective relevant to this product.
Product objective	What is the objective of the product? Objectives need to be specific (addressing customer requirements) and measurable.
Background	Introduction or background to the product including, where appropriate, identified customer requirements.
Product description	
Scope	Identify the broad boundaries of the product and what it is designed to achieve with a specific focus on any customer requirements. It is also useful to consider what may be outside the scope of the product.
Deliverables	What are the deliverables?

3. JUSTIFICATION	
Expertise	
Benefits	Provide an explanation as to why this initiative has been identified as a priority and describe associated desired benefits/outcomes. Include links to the NMHS objectives, priorities and strategic plans, and describe how the initiative meets identified customer needs.
Impact	What would be the consequences if this product were not developed?

4. COMMUNICATION STRATEGIES				
Description	*Target audience*	*Delivery method*	*Frequency*	*Responsibility*

How are details of the product going to be communicated to the stakeholders and in particular to key customers? Include meeting, liaison and progress reports. Progress reports should be prepared at agreed time intervals or at key milestones. They shall include the actual progress in relation to the scheduled activities (including cost, time and performance).

5. EVALUATION METHODS			
Description	*Methodology*	*Target*	*Responsibility*

Clearly define the key performance indicators (measures showing that the initiative has been successfully completed).

6. MILESTONES			
	Accountability	*Dates*	*Status*
Milestone 1:			
Milestone 2:			
Milestone 3:			
Milestone 4:			
Milestone 5:			
Milestone 6:			

7. RISK SUMMARY			
Risk description	*Likelihood*	*Mitigating strategies developed and implemented Yes/No?*	*Residual risk*

8. BUDGET				
Description	** 2012-13*	**2013-14*	**2014-15*	*Ongoing*
Salaries				
Goods and services				
Overheads				
Total				

* Or include months if it is to be completed within a specific financial year

APPENDIX 2. GENERIC PRODUCT ACCEPTANCE TEMPLATE

Please note that the term "product" is interchangeable with the term "service". In the context of maximizing the use of this planning template, it can also be substituted with the word "project" to cover specific projects that the National Meteorological and Hydrological Service (NMHS) undertakes.

1. PRODUCT OVERVIEW				
Product name				
NMHS programme				
Start/End date				
Stakeholders	List the key stakeholders or stakeholder groups who will be affected by the initiative. Stakeholders provide or receive a service; they are critical to the success of the initiative.			
Related activities	List any related activities that depend on this initiative or on which it depends. They may share data, function, technology or staff with the project.			
Product authority	Detail the lines of authority and responsibility			
Product funding	Identify the source of funding			
Product team	**Name**	**Position/Section**	**Phone**	**Email**
Sponsor				
Manager				

2. PRODUCT DESCRIPTION	
Objective	What is the objective of the product? Objectives need to be specific (addressing customer requirements) and measurable.
Description	
Scope	Identify the broad boundaries of the product and what it is designed to achieve with a specific focus on any customer requirements. It is also useful to consider what may be outside the scope of the product.
Deliverables	What are the deliverables?

3 ACCEPTANCE INFORMATION	
Expertise	
Method	Describe the mechanism used to obtain formal agreement for deployment. The mechanism may, for example, involve a face-to-face meeting, teleconference, or some other formal approach to specifically obtain agreement to deploy the product.
Representatives	Identify who was involved in acceptance and which functional areas (e.g. programme staff, vendor, finance and quality) were represented. Include name, role or title, section and organisation.
Documentation	Describe documents used as supporting material during acceptance and specify whether the documents required a formal signature for approval.

4. ACCEPTANCE CHECKLIST		
Item	*Question*	
4.1	Did you formally approve plans that identify operational requirements, service readiness, training, knowledge transfer, rollout strategy, and other core activities/factors that are necessary to effectively move a technology-based product and/or service to an operational status? For example, did you approve a deployment plan, training plan, operations and maintenance plan, and/or a product release plan?	Yes ☐ No ☐
4.2	Did you formally accept all test results?	Yes ☐ No ☐
4.3	Do you accept that the product and/or service is ready to be operational?	Yes ☐ No ☐
4.4	Do you agree that the product and/or service has sufficiently met the stated business goals and objectives?	Yes ☐ No ☐
4.5	Do you fully understand and agree to accept all operational requirements, operational risks, maintenance costs and other limitations and/or constraints imposed as a result of making the product and/or service operational?	Yes ☐ No ☐

Answer each question. For each "no" response, include an issue in the Open Issues section.

5. OPEN ISSUES	
Issue	*Planned resolution*

Describe any open issues and plans for their resolution within the context of formally accepting deployment of the product and/or service. Include an open issue for any "no" responses in the Acceptance Checklist section.

8. BUDGET			
Approver	*Signature*	*Date*	*Comments*

Note: Approval of this product acceptance indicates an understanding and formal agreement that the product and/or service has been developed and implemented in accordance with the plan and is now complete or operationally implemented.

APPENDIX 3. EXAMPLE OF A CUSTOMER SATISFACTION SURVEY

NATIONAL METEOROLOGICAL AND HYDROLOGICAL SERVICE

CUSTOMER SATISFACTION SURVEY

Please answer the following questions by ticking the appropriate box/es.

CUSTOMER INFORMATION

1. Please indicate your industry sector (insert country industry sectors here as per examples below):

☐ Commercial shipping
☐ Commercial fishing
☐ Marine regulatory organization
☐ Emergency services
☐ Recreational maritime sector
☐ Search and rescue organization
☐ Aviation
☐ Coastguard organization
☐ Port authorities
☐ Offshore industry sector
☐ Defence force
☐ Commercial boating industry
☐ Commerce
☐ Agriculture

PRODUCTS AND SERVICES

2. Which products and services do you use? (Insert the suite of products of the National Meteorological and Hydrological Service (NMHS) here as per examples below)

☐ Tsunami warning
☐ Tropical cyclone warning
☐ Severe thunderstorm warning
☐ Search and rescue
☐ Severe weather warning
☐ Coastal waters warnings
☐ Metropolitan waters warning
☐ Ocean waters warning
☐ Ditching report
☐ Public telephone briefing
☐ Tidal services
☐ Other (please specify):
☐ Metropolitan waters forecast
☐ Tropical cyclone advisory
☐ High seas forecast
☐ Tropical cyclone outlook
☐ Land waters forecast
☐ Island forecasts
☐ Observation products
☐ Flood warnings
☐ Storm tide alerts
☐ Coastal waters forecast
☐ High seas/ocean forecasts

3. How would you rate the professionalism of the NMHS personnel?

☐ Highly professional ☐ Professional ☐ Unprofessional

4. How would you rate the responsiveness of the NMHS personnel?

☐ Always responsive ☐ Mostly responsive ☐ Unresponsive

5. How would you rate the overall accuracy of the products and services?

☐ Always accurate ☐ Usually accurate ☐ Inaccurate

6. How would you rate the overall timeliness of the NMHS products and services?

☐ Always on time ☐ Mostly on time ☐ Never on time

7. How would you rate the ease of use of the NMHS products and services?

☐ Very easy to use ☐ Mostly easy to use ☐ Not easy to use

8. How would you rate the accessibility of the NMHS products and services?

☐ Easy to access ☐ Mostly easy to access ☐ Not easy to access

9. Do the services provided by the NMHS contribute to enhancing the economic viability of your operations?

☐ Always ☐ Mostly ☐ Rarely

10. Do the services provided by the NMHS contribute to enhancing the safety of your operations?

☐ Always ☐ Mostly ☐ Rarely

11. Do the services provided meet the needs of your organization?

☐ Always ☐ Mostly ☐ Rarely

12. What impact do you believe the NMHS services are having on your operations?

☐ Always positive ☐ Mostly positive ☐ Negligible

13. What is your level of overall satisfaction with the NMHS services?

☐ Very satisfied ☐ Fairly satisfied ☐ Dissatisfied

14. Can you suggest ways in which we could improve the NMHS services?

APPENDIX 4. EXAMPLE OF A GENERIC NON-CONFORMANCE PROCEDURE

Procedure for rectifying and reporting non-conforming products, and for identifying preventive action

1. Non-conforming products are normally identified through:

(a) Recognition by the duty officer that a product is outside the set criteria articulated in the operational documentation of the National Meteorological and Hydrological Service (NMHS);

(b) Real-time feedback from the community and relevant industry sectors while the product is current;

(c) Feedback from the community and relevant industry sectors, for example at a consultative meeting or through a Web feedback form concerning a product or service provided previously;

(d) A request from an official regulatory body or relevant police service.

2. Non-conformities that are identified in the following circumstances will be eliminated or rectified as expediently as possible:

(a) An operational version of the product is currently available and the non-conformance is brought to the attention of the duty officer, who expediently issues an amendment to rectify the non-conformance;

(b) An operational version of the product is currently available and the non-conformance is identified by the duty officer, who expediently issues an amendment to rectify the non-conformance;

(c) The non-conformance has been identified in a product or service delivered previously, following a request for an investigation. The investigation and preparation of reports in response to such requests should comply with all specified requirements including those of judicial and coronial investigations or any other procedures as specified by the investigating body;

(d) A non-conformance is raised/tabled at an industry forum. Every effort shall be made to identify the product(s) in question and the officer responsible for issuing the product(s);

(e) Non-conformance of a product or service previously delivered is identified through other (internal) means such as post-analysis or other investigation. The non-conformance should be brought to the attention of the officer in charge and any corrective action expediently taken.

3. Outcomes pertaining to a non-conformance shall, where appropriate, be reported back to the individual or organization that notified the non-conformance.

4. All actions pertaining to correcting a non-conformance (other than amendments to operationally current products (see 1 (a) and 1 (b) above)) shall be recorded on an appropriate official NMHS incident file in the office concerned.

5. The preventive actions recommended are then addressed from a number of perspectives:

(a) By identifying and assessing the competencies (see subclause 6.2.2) required for the delivery of the service and providing the appropriate training as applicable;

(b) In the event of an investigation, by identifying preventive actions under the following subheadings: procedural, information/data, equipment/instrumentation, training and other, in the investigation form, and by responding to recommendations that arise out of the formal investigation report;

(c) The preventive actions from any maritime investigation are standing agenda items at the quality management review meetings, as identified in subclause 5.6.2 Review input.

APPENDIX 5. SAMPLE JOB DESCRIPTION: QUALITY MANAGER

Job profile

Role of the Quality Management Section

The fundamental role of the Quality Management Section is to deliver a comprehensive range of quality management services, skills and knowledge. These are to be provided on a cross-sectional basis to enable all sections to integrate a quality management system into all facets of their service delivery and achieve certification of compliance with the ISO 9001 quality management Standard.

Role of the position

The role of the Quality Manager is to provide effective and efficient management of the Quality Management Section.

Functions of the position

The occupant's prime responsibility, under broad policy control and direction from the Director of the National Meteorological an Hydrological Service (NMHS) is to manage and coordinate the Quality Management Section to provide a cross-sectional, comprehensive range of quality management services, skills, knowledge and advice. This will enable the NMHS to be certified to ISO 9001.

The position requires a sound knowledge of the ISO 9001 Standard and competence as a lead auditor of management systems, or demonstrated ability to attain such competence, in accordance with ISO 19011:2011.

The position requires a high level of leadership and management skills as the occupant will have to manage the broad range of activities provided by the Quality Management Section. These will include development of quality manuals, analysis and assessment of service delivery and product realization procedures, planning, training, quality management system implementation and internal audits. The occupant must also assist and mentor colleagues through the ongoing audit process and continual improvement of procedures before and after certification.

The position also calls for a high level of strategic and change management skills. The occupant is required to build cross-programme partnerships and communicate effectively with NMHS staff at all levels. He/she must also have a high standard of written and verbal communication skills in order to effectively manage change and follow projects through to completion.

The occupant is also required to show independent judgement, initiative, maturity and a commitment to personal development.

Duty statement

1. Planning and leading the development and implementation of quality management systems appropriate to the National Meteorological and Hydrological Service (NMHS). This may include compliance with and certification to ISO 9001 and its ongoing monitoring and maintenance, in particular the preparation of medium- and long-term plans for the implementation of quality management systems across the Service.

2. Planning and conducting internal audits of the quality management systems to evaluate their efficiency and effectiveness for the continuous improvement of service delivery.

3. Planning and co-ordinating management reviews of the quality management initiatives to evaluate their efficiency and effectiveness for the continuous improvement of services.

4. Planning, organizing and coordinating the activities of the Quality Management Section.

5. Representing the NMHS at inter-departmental, national, international and other conferences and committees relating to quality management and the ISO 9000 Standards.

6. Managing the financial and physical resources of the Quality Management Section.

7. Ensuring continuous personal development for staff through proactive liaison, education and training applicable to quality management and associated activities.

8. Providing support and advice to the NMHS on document control issues under the quality management system.

Selection criteria

1. **Leadership and management.** Demonstrated leadership and change management skills. The ability to carry initiatives through their entire life cycle, including feasibility, planning, implementation, evaluation and review. The ability to think and plan strategically, marshal professional expertise, manage change and achieve intended results.

2. **Quality management and auditing.** Demonstrated extensive knowledge of quality management system practices and principles and sound appreciation of the requirements for third-party certification to ISO 9001 Standard. Demonstrated experience and ability to conduct internal audits in accordance with ISO 9001, and demonstrated ability to attain qualifications as a lead auditor of management systems in accordance with ISO 19011:2011.

3. **Delivery of weather services.** A demonstrated knowledge of the roles and interactions of the various programmes and sections of the NMHS combined with a demonstrated knowledge of and experience in the delivery of weather services at a national and international level.

4. **Customer focus.** A demonstrated commitment to high-quality client services and ongoing improvement through a focussed approach to the quality management principles and practices whilst meeting identified customer needs.

5. **Communication skills.** A demonstrated ability to communicate clearly at a senior level both verbally and in writing. The ability to negotiate persuasively and to listen, understand and adapt to different audiences throughout the NMHS and broad sectors of the national and international community.

6. **Drive and commitment.** Demonstrated proactive decision-making skills and the motivation to commit to action. Self-awareness, personal courage, resilience and the commitment to personal development.

APPENDIX 6. ENLISTING THE ASSISTANCE OF AN EXPERIENCED ORGANIZATION OR INDIVIDUAL

Potential questions

- Could they provide an overview of their quality management background?
- Does the National Meteorological and Hydrological Service (NMHS) present any unique challenges they have or have not faced previously? If so, what are those challenges and how did they deal with them?
- Do they believe the "drivers" to adopt ISO 9001 quality management Standard are legitimate?
- What approach do they believe would be the most appropriate for the NMHS to be certified in accordance with ISO 9001?
- What would they need from the NMHS to initiate the project?
- What strategies do they employ to maintain a close working relationship with the organization and to ensure that the project is carried through smoothly whilst minimising time and costs?
- Can they provide examples of work they have previously done for other organizations or NMHSs?
- If they are selected for or accept the challenge of assisting the NMHS and it does not pass certification the first time, what action would they take to ensure that certification is achieved?
- Do they provide quality management training services and, if so, do they have qualified trainers? Are they registered as an internationally recognized training organization?
- Do they guarantee their services?
- Can they provide a fixed schedule of charges, if charges are applicable?

APPENDIX 7. GAP ANALYSIS TOOLS

Part A. GAP Analysis

GAP ANALYSIS	
Quality management system:	
Scope of gap analysis (area being analysed):	
Gap analysis date:	
Gap analysis completion date:	
Gap analysis conducted by:	

This gap analysis tool is aligned with *ISO 9001:2008, Quality management system – Requirements*, and is divided into five sections which reflect the contents of ISO 9001.

A traffic light system is used to indicate the level of compliance with the specific requirements of the Standard and thus highlight the gaps that exist between those requirements and the current management system:

	Green - minimum compliance
	Amber - partial compliance
	Red - no compliance

Notes:

1. This gap analysis must be conducted with due reference to the clauses articulated in ISO 9001. This document provides only the specific clause numbers, not the content.
2. Throughout this gap analysis the term quality management system (QMS) covers the scope of all the activities of the National Meteorological and Hydrological Services (NMHSs). The terms "QMS" and "NMHS activities" are interchangeable and can be interpreted to mean one and the same.
3. Any mention of NMHS procedures, documentation and resources refers to those NMHS activities that have been identified as being within the scope of the QMS.
4. This tool is broadly based on a Gap Analysis Tool developed by Praxiom Research Group. It should be noted that Praxiom also provides other valuable quality management information on itsWebsite and the reader is encouraged to visit it.

Gap analysis questions	*Status*	*Comments*
4 QUALITY MANAGEMENT SYSTEM		
Standard clause (see ISO 9001:2008)		
4.1 GENERAL REQUIREMENTS		
1. Have you identified all the processes and resources required to carry out the NMHS management activities, measure performance, realize its suite of products and make improvements? 2. Have you established methods, criteria and specific key performance indicators to ensure that each process is effective? 3. Where appropriate, have you documented the interactions between your NMHS processes and how they are managed and controlled? 4. Do you believe your processes have the appropriate level of resources? 5. Do you provide the appropriate level of information and instructions that the NMHS requires for its operations and monitoring? 6. Do you control, monitor, measure and analyse process performance?		
4.2 DOCUMENTATION REQUIREMENTS		
4.2.1 GENERAL		
7. Do you have a list of all the documentation that the NMHS utilizes? Please provide this list. 8. Have you developed and documented a quality policy? 9. Have you identified and established the documentation and records such as e-mail policy and filing/archiving of folios that your NMHS requires? 10. Do the documents of your NMHS accurately reflect what you do and how you do it? 11. Have you considered and established the interaction and hierarchy of QMS documentation?		
4.2.2 QUALITY MANUAL		
12. Has a quality manual been prepared for your QMS? 13. Does it accurately define the scope (boundary) of your QMS? 14. Does it justify all exclusions? 15. Are your NMHS procedures well documented and/or referenced in the quality manual? 16. Does the quality manual describe or provide a diagram depicting how the processes of your NMHS interact with one another?		
4.2.3 CONTROL OF DOCUMENTS		
17. Do you use the quality management document control procedures for the documents of your NMHS? 18. Are documents approved prior to distribution or reviewed and re-approved whenever they are updated or revised? If so who approves them? 19. Is there a schedule for the revision of documentation and is the status specified? 20. Do you identify and manage documents from external sources which are required for the activities of your NMHS?		
21. Do you ensure the provision of the correct version of QMS documents at points of use? 22. Do you prevent the accidental use of obsolete QMS documents? 23. Do you identify obsolete documents that are retained and, if so, how?		

Gap analysis questions	*Status*	*Comments*
4.2.4 CONTROL OF RECORDS		
24. Are the records of your NMHS useable? 25. Are they legible? 26. Are they identifiable? 27. Are they retrievable? 28. Can the records of your NMHS be used as a reliable source of evidence? 29. Can they prove that requirements have been met?		
5. MANAGEMENT RESPONSIBILITY		
Standard clause (see ISO 9001:2008)		
5.1 MANAGEMENT COMMITMENT		
1. Do you believe the top management of the NMHS fully supports the development and implementation of a QMS? 2. Do you believe it supports the development of a quality policy? 3. Do you believe it supports the development of quality objectives? 4. Do you believe it demonstrates its support by ensuring that resources are available for the QMS? 5. Do you believe it communicates how important it is to meet requirements? 6. Do you believe it explains why it is important to meet customer requirements? 7. Do you believe it explains why it is important to meet statutory and regulatory requirements? 8. Do you believe it supports efforts to continually improve the effectiveness of your NMHS activities? 9. Does it support continual improvement by conducting an adequate number of quality management reviews?		
5.2 CUSTOMERS FOCUS		
10. Has your NMHS identified its key stakeholders and in particular its customers? 11. Does your NMHS enhance customer satisfaction by ensuring that customer requirements are identified and met? 12. Does your NMHS periodically review its customer requirements? 13. Does your NMHS conduct periodic customer satisfaction surveys to ensure that requirements are being met?		
5.3 QUALITY POLICY		
14. Does your quality policy serve your NMHS overall purpose? 15. Does your quality policy make a commitment to continually improve the effectiveness of the QMS by meeting its objectives? 16. Is your quality policy communicated, discussed and understood throughout the NMHS? 17. Do you periodically review your quality policy to make sure that it is still suitable?		
5.4 PLANNING		
5.4.1 QUALITY OBJECTIVES		
18. Do top managers support the establishment of quality objectives for your NMHS? 19. Do top managers support the establishment of quality objectives for your products? 20. If your NMHS has established specific organizational objectives, were they developed in collaboration with the staff? 21. Are the objectives of your NMHS effective and, if so, how was this established? 22. Are the objectives of your NMHS measurable? 23. Do the objectives of the NMHS support your quality policy? 24. Do your objectives support the objectives/targets of the NMHS strategic and operational plan?		

Gap analysis questions	*Status*	*Comments*
5.4.2 QUALITY MANAGEMENT SYSTEM PLANNING		
25. Have you planned for the ongoing maintenance of your QMS? 26. Have you planned for the continual improvement of your QMS? 27. Will you endeavour to protect the integrity of your QMS whenever systemic changes are being planned and implemented?		
5.5 RESPONSIBILITY, AUTHORITY AND COMMUNICATION		
5.5.1 RESPONSIBILITY AND AUTHORITY		
28. Have QMS responsibilities and authority been defined? 29. Are QMS responsibilities and authority communicated throughout your NMHS?		
5.5.3 INTERNAL COMMUNICATION		
30. Do your top managers ensure that communication processes are established and routinely followed within your NMHS? 31. Do they ensure that QMS effectiveness is formally and informally discussed?		
5.6 MANAGEMENT REVIEW		
5.6.1 GENERAL		
32. Do top managers review the QMS at planned intervals? 33. Do they review the ongoing suitability, adequacy and effectiveness of the QMS? 34. Do top managers evaluate improvement opportunities? 35. Do top managers formally assess the need to make changes to the QMS and quality policy? 36. Do they assess the need to change quality objectives? 37. Do top managers keep a record of management reviews?		
5.6.2 REVIEW INPUT		
38. Do top managers examine previous management reviews? 39. Do they examine the results of previous audits? 40. Do they examine feedback from customers? 41. Do they examine product conformity data? 42. Do they examine process performance information? 43. Do they examine the status of previous actions? 44. Do they examine the status of corrective actions? 45. Do they examine the status of preventive actions? 46. Do they examine opportunities for improvement? 47. Do they examine previous follow-up actions?		
5.6.3 REVIEW OUTPUT		
48. Do top managers generate management review decisions and actions (outputs) to improve the NMHS? 49. Do they generate decisions and actions to improve the suitability of the QMS? 50. Do they generate decisions and actions to improve the effectiveness of the QMS processes? 51. Do they generate decisions and actions to improve the products of the NMHS? 52. Do they generate management review decisions and actions to improve the ability of their products to meet customer requirements?		
53. Do they generate management review decisions and actions to change the quality policy as and when appropriate? 54. Do they generate management review decisions and actions, as and when appropriate, to change the quality objectives? 55. Do top managers generate management review decisions and actions to address resource needs?		

Gap analysis questions	*Status*	*Comments*
6 RESOURCE MANAGEMENT		
Standard clause (see ISO 9001:2008)		
6.1 PROVISION OF RESOURCES		
1. Have you identified the resources needed to implement, maintain and improve the QMS of your NMHS? 2. Have you identified the resources needed to ensure that customers' needs are being met and to help enhance customer satisfaction?		
6.2 HUMAN RESOURCES		
6.2.1 GENERAL		
3. Have you clearly identified the qualifications, skills, knowledge and experience required of the staff in your NMHS? 4. Do you ensure that all staff employed within your NMHS have the appropriate, qualifications, skills, knowledge and experience?		
6.2.2 COMPETENCE, TRAINING AND AWARENESS		
5. Do you identify the competence requirements of personnel within your QMS who perform tasks that could directly or indirectly affect the ability of your NMHS to meet product requirements? 6. Do you provide training, or take other suitable steps, to meet the unique competency requirements of your NMHS? 7. Do you make your personnel aware of how their activities can affect the ability of the NMHS to meet product requirements and how important their efforts are? 8. Do you explain how personnel can help your NMHS to achieve its quality objectives? 9. Do you evaluate the effectiveness of your training and awareness activities? 10. Do you maintain suitable records which show that personnel within your NMHS are competent? 11. Do you maintain appropriate records of education, training, experience and skills?		
6.3 INFRASTRUCTURE		
12. Have you identified the infrastructure that your NMHS needs in order to ensure that product requirements are met? 13. Have you identified and been provided with workspace, equipment, hardware and software? 14. Have you defined your communication and support service needs? 15. Are adequate support services for communication and information in place to ensure that products meet requirements?		
6.4 WORK ENVIRONMENT		
16. Is there a mechanism to ensure that the work environment that your NMHS needs is appropriately managed and maintained?		

Gap analysis questions	*Status*	*Comments*
7 PRODUCT REALIZATION		
Standard clause (see ISO 9001:2008)		
7.1 PLANNING OF PRODUCT REALIZATION		
1. Have you identified the resources that you will need in order to realize your products? 2. Do you use planning processes for the realization of the products of your NMHS? 3. Do you use your product planning process to specify product/service quality objectives and requirements? 4. Have you identified the documents that are required to ensure the consistent realization of the suite of products? 5. Have you identified the records that are required to prove that your processes and products meet requirements? 6. Have you identified the product acceptance criteria that you will need to use in order to decide whether or not products meet requirements? 7. Have you identified the monitoring, measurement and verification methods that you will need to use in order to control product quality?		
7.2 CUSTOMER-RELATED PROCESSES		
7.2.1 DETERMINATION OF REQUIREMENTS RELATED TO THE PRODUCT		
8. Have you identified your customers' product and delivery requirements? 9. If applicable, have you identified customer contractual requirements? 10. Have you identified the regulatory and/or statutory requirements that are imposed on your products by external agencies?		
7.2.2 REVIEW OF REQUIREMENTS RELATED TO THE PRODUCT		
11. Do you review your customer product requirements? 12. Do you consider your customers' product requirements before you agree to supply products to them? 13. Do you amend relevant documents to reflect changes in your customer product requirements? 14. Do you record any follow-up actions taken in response to your product requirement reviews? 15. Do you maintain a record of your product requirement reviews? 16. Do you consider your customer product requirements before you accept contracts or contractual changes? 17. Do you verify that customers' product requirements are specified before you agree to supply products to them? 18. If applicable, do you resolve differences between the original quote and the final order before you agree to supply products to your customers? 19. Do you establish that the NMHS is able to meet your customers' product requirements before you agree to supply products to them? 20. Do you communicate changes in your customer product requirements to all relevant personnel and if so how?		
7.2.3 CUSTOMER COMMUNICATION		
21. Have you established an effective customer communication plan? 22. Have you established a process to handle customers' enquiries, feedback and complaints? 23. Do you control how product information is provided to your customers?		

Gap analysis questions	*Status*	*Comments*
24. Do you control how contracts are provided to your customers? 25. Do you control how amendments to contracts are agreed and implemented?		
7.3 DESIGN AND DEVELOPMENT		
7.3.1 DESIGN AND DEVELOPMENT PLANNING		
26. Do you plan and control the design and development of your NMHS products? 27. Do you plan and control the assignment of authority and responsibility for product design and development? 28. Do you plan and control the review activities for each stage? 29. Do you plan and control the verification activities for each stage? 30. Do you plan and control the interaction between groups who participate in the product design and development process? 31. Do you plan and control how groups will communicate with each other? 32. Do you ensure that group responsibilities are clearly defined and assigned?		
7.3.2 DESIGN AND DEVELOPMENT INPUTS		
33. Do you define product design and development inputs and performance requirements? 34. Do you define your product's functional, statutory and regulatory requirements? 35. Do you maintain a record of product design and development inputs? 36. Do you review product design and development inputs? 37. Do you ensure that input ambiguities and contradictions are eliminated and resolved?		
7.3.3 DESIGN AND DEVELOPMENT OUTPUTS		
38. Do you specify product characteristics that are crucial to the safe use of the product? 39. Do you provide appropriate information to support your production process? 40. Do you provide appropriate information to support your service provision process? 41. Do design and development outputs contain or refer to product acceptance criteria? 42. Do you approve product design and development outputs before they are formally released? 43. Do you verify that design and development outputs meet design and development input requirements?		
7.3.4 DESIGN AND DEVELOPMENT REVIEW		
44. Do you perform systematic design and development reviews at suitable stages throughout the design and development process? 45. Do staff participate in the review of the design and development stages that concern them? 46. Do you assess how well design and development results are meeting requirements? 47. Do you identify design and development problems? 48. Do you propose follow-up actions and solutions? 49. Do you maintain a record of your design and development reviews? 50. Do you record the results of your design and development reviews? 51. Do you record the actions you take to follow up on reviews?		

Gap analysis questions	*Status*	*Comments*
7.3.5 DESIGN AND DEVELOPMENT VERIFICATION		
52. Do you carry out design and development verification activities ? 53. Does design and development verification follow planned arrangements? 54. Do you maintain records of your design and development verification activities? 55. Do you record actions taken to follow up verification activities?		
7.3.6 DESIGN AND DEVELOPMENT VALIDATION		
56. Do you perform design and development validation activities? 57. Do you confirm that a new product meets the requirements that define its intended use or application (if this is known)? 58. Do you conduct design and development validation before a new product is made or delivered ? 59. Do you maintain records of your design and development validation activities? 60. Do you record the results of design and development validation activities? 61. Do you record actions taken to follow up on validation?		
7.3.7 CONTROL OF DESIGN AND DEVELOPMENT CHANGES		
62. Do you identify and record changes in design and development? 63. Do you evaluate the impact of changes? 64. Do you assess the impact that changes will have on previously delivered products? 65. Do you maintain a record of your review of changes in design and development? 66. Do you approve changes in design and development before you implement those changes?		
7.4 PURCHASING		
7.4.1 PURCHASING PROCESS		
67. Have you established criteria to select and evaluate suppliers? 68. Do you evaluate your suppliers' ability to supply products that meet the requirements of your NMHS? 69. Do you record the evaluations of your suppliers? 70. Do you ensure that purchased products meet specified purchase requirements?		
7.4.2 PURCHASING INFORMATION		
71. Do you ensure that purchasing requirements are adequately specified before you discuss them with suppliers?		
7.4.3 VERIFICATION OF PURCHASED PRODUCT		
72. Have you established product verification or inspection methods in order to ensure that purchased products meet purchase requirements?		

Gap analysis questions	*Status*	*Comments*
7.5 PRODUCTION AND SERVICE PROVISION		
7.5.1 CONTROL OF PRODUCTION AND SERVICE PROVISION		
73. Is production carried out under controlled conditions? 74. Have you established a plan to monitor production and service delivery? 75. Do you plan how operational procedures will be used to monitor production and service delivery? 76. Do you plan how measurements will be used to monitor production and service delivery? 77. Do you plan how post-delivery activities will be used to monitor production?		
7.5.2 VALIDATION OF PROCESSES FOR PRODUCTION AND SERVICE PROVISION		
78. Do you verify production and service provision processes whenever process outputs cannot be measured, monitored or verified until after the product is in use or the service has been delivered? 79. Do you use criteria to help verify production processes? 80. Do you use procedures to help verify production processes? 81. Do you use qualification approvals to check the competence of the NMHS personnel?		
7.5.3 IDENTIFICATION AND TRACEABILITY		
82. Have you established and do you preserve the unique identity of your NMHS products throughout the product realization process? 83. Do you maintain a record of the identity of your product whenever traceability is a requirement? 84. Do you maintain the monitoring and measurement status of your NMHS products throughout the product realization process?		
7.5.4 CUSTOMER PROPERTY		
85. Do you identify property supplied to you by customers? 86. Do you verify property supplied to you by customers? 87. Do you protect property supplied to you by customers? 88. Do you safeguard property supplied to you by customers? 89. Do you take care of property supplied to you by customers while it is under your control?		
7.5.5 PRESERVATION OF PRODUCTS		
90. Do you preserve the products and components of your NMHS during internal processing? 91. Do you use suitable identification methods to preserve products and components during processing and delivery to the intended destination? 92. Do you preserve your products and components during delivery?		

Gap analysis questions	*Status*	*Comments*
8 MEASUREMENT, ANALYSIS AND IMPROVEMENT		
Standard clause (see ISO 9001:2008)		
8.1 GENERAL		
1. Have you identified and implemented the monitoring, measurement and analytical processes that your NMHS needs to be able to demonstrate conformity with the ISO Standard in question and make improvements? 2. Have you identified and implemented the monitoring and measurement processes that are required to continually improve the effectiveness of your NMHS? 3. Have you identified and implemented the monitoring and measurement processes that will allow you to continually improve the effectiveness of your NMHS?		
4. Have you identified and implemented any statistical measurement methods that will allow you to show that your products meet the requirements? 5. Have you identified and implemented any analytical processes that will allow your NMHS to ensure that requirements are being met and continually improved? 6. Do you use your monitoring processes to continually improve the effectiveness of your NMHS?		
8.2 MONITORING AND MEASUREMENT		
8.2.1 CUSTOMER SATISFACTION		
7. Have you established and implemented methods to monitor and measure customer satisfaction (perception)? 8. Are your methods capable of monitoring and measuring how well your NMHS meets customer requirements? 9. Have you established how you are going to use customer satisfaction (perception) information? 10. Do you use customer satisfaction as a measure of the performance of your NMHS?		
8.2.2 INTERNAL AUDIT		
11. Is there an established and implemented internal audit procedure? 12. Is your internal audit procedure documented? 13. Are there instructions for the planning of audits? 14. Does your procedure define how audit records should be established? 15. Does your procedure specify how often internal audits should be performed? 16. Are internal audits scheduled at planned intervals? 17. Are the results of previous internal audits considered? 18. Is the scope of your internal audits stated? 19. Is there a mechanism to ensure that auditors do not audit their own work? 20. Are audit records maintained? 21. Is a record of audit results maintained? 22. Are actions taken to address audit results? 23. Do managers take corrective action whenever non-conformities are found in their areas? 24. Do managers address causes of non-conformities? 25. Are actions taken in a timely manner? 26. Do you follow up on the corrective actions taken by managers to address non-conformities? 27. Do you verify that corrective actions were taken? 28. Do you report the results of verification activities?		

Gap analysis questions	*Status*	*Comments*
8.2.3 MONITORING AND MEASUREMENT OF PROCESSES		
29. Do you use your monitoring and measurement methods to demonstrate that your QMS processes are achieving the planned results for the NMHS? 30. Do you take appropriate corrective action whenever the processes of your NMHS fail to achieve the expected results?		
8.2.4 MONITORING AND MEASUREMENT OF PRODUCT		
31. Do you use your monitoring methods to verify product characteristics? 32. Can your product monitoring records prove that acceptance criteria were met? 33. Do your product monitoring records indicate who was responsible for authorizing the release of products for delivery to customers? 34. Do you perform planned monitoring and measuring activities before products are released and services delivered?		
8.3 CONTROL OF NON-CONFORMING PRODUCT		
35. Have you established and documented a non-conforming product procedure for your NMHS? 36. Does your procedure explain how to identify and control non-conforming products? 37. Does your procedure specify how to correct the non-conforming products of your NMHS? 38. Does your procedure specify how to prevent the unintended delivery or use of non-conforming products? 39. Does your procedure specify how to address the effects and consequences of the delivery or use of non-conforming products? 40. Does your procedure define and allocate responsibilities for non-conforming products? 41. Does your procedure describe how non-conforming product records will be managed and maintained? 42. Do you correct non-conforming products? 43. Do you re-verify non-conforming products to ensure that they meet product requirements? 44. Do you eliminate detected non-conformities? 45. Do you address the effects and consequences of the delivery or use of non-conforming products? 46. Do you maintain a record of product non-conformities? 47. Do you describe the actions taken to deal with non-conforming products?		
8.4 ANALYSIS OF DATA		
48. Do you collect data about the QMS in your NMHS to establish its suitability and effectiveness? 49. Is information about customer satisfaction provided to the NMHS staff? 50. Do NMHS staff receive information on how to prevent product non-conformities?		

Gap analysis questions	*Status*	*Comments*
8. 5 IMPROVEMENT		
8.5.1 CONTINUAL IMPROVEMENT		
51. Do you work towards continually improving the overall effectiveness of the NMHS? 52. Do you use data analysis and objectives to make improvements? 53. Do you use audit results to make improvements? 54. Do you use management reviews to make improvements? 55. Do you use corrective actions to make improvements? 56. Do you use preventive actions to make improvements?		
8.5.2 CORRECTIVE ACTION		
57. Have you established, documented and implemented a corrective action procedure? 58. Does your corrective action procedure expect you to deal with the impact of actual non-conformities? 59. Does your corrective action procedure expect you to eliminate the causes of actual non-conformities? 60. Have you described how corrective actions will be recorded? 61. Have you described how the effectiveness of previous actions will be reviewed?		
8.5.3 PREVENTIVE ACTION		
62. Have you established, documented and implemented a preventive action procedure? 63. Does your preventive action procedure expect you to prevent the occurrence of potential non-conformities? 64. Does your preventive action procedure expect you to eliminate the causes of potential non-conformities? 65. Does your preventive action procedure expect you to deal with the effects of potential non-conformities?		

Part B. Gap analysis findings

GAP ANALYSIS FINDINGS (please insert the official name of the NMHS here)	
Quality management system:	
Scope of gap analysis (area being analysed):	
Gap analysis date:	
Gap analysis completion date:	
Gap analysis conducted by:	
Note: The gap analysis findings include the remedial actions that are recommended to rectify the identified gaps between ISO 9001 and the current management system. The remedial actions are cross-referenced to the corresponding ISO clause. There should be an officer in charge of each remedial action to ensure that it is actually carried out. As actions are performed and gaps eliminated, record the date when the gap was filled to indicate completion. The review date for remedial actions is: (insert date here).	

Standard clause (ISO 9001)		Gap identified	Proposed remedial action	Responsible officer	Date gap was eliminated
The gap analysis findings must refer to clauses articulated in ISO 9001. This document only provides the specific clause numbers, not their content.		In order to complete this column simply cut and paste information from Part A.	Actions stated here will be developed in close consultation with staff working in the area under consideration. Ensure that remedial actions are comprehensive and feasible, and will meet the requirements of the relevant ISO 9001 clause.	A senior manager from the area being analysed should be responsible for ensuring actions are implemented.	
4	**QUALITY MANAGEMENT SYSTEM**				
4.1	GENERAL REQUIREMENTS				
4.2	DOCUMENTATION REQUIREMENTS				
4.2.1	General				
4.2.2	Quality manual				
4.2.3	Control of documents				
4.2.4	Control of records				
5	**MANAGEMENT RESPONSIBILITY**				
5.1	MANAGEMENT COMMITMENT				
5.2	CUSTOMER FOCUS				
5.3	QUALITY POLICY				

5.4	PLANNING				
5.4.1	Quality objectives				
5.4.2	Quality management system planning				
5.5	RESPONSIBILITY, AUTHORITY AND COMMUNICATION				
5.5.1	Responsibility and authority				
5.5.2	Management representative				
5.5.3	Internal communication				
5.6	MANAGEMENT REVIEW				
5.6.1	General				
5.6.2	Review input				
5.6.3	Review output				
6	**RESOURCE MANAGEMENT**				
6.1	PROVISION OF RESOURCES				
6.2	HUMAN RESOURCES				
6.2.1	General				
6.2.2	Competence, training and awareness				
6.3	INFRASTRUCTURE				
6.4	WORK ENVIRONMENT				

7	**PRODUCT REALIZATION**				
7.1	PLANNING OF PRODUCT REALIZATION				
7.2	CUSTOMER-RELATED PROCESSES				
7.2.1	Determination of requirements related to the product				
7.2.2	Review of requirements related to the product				
7.2.3	Customer communication				
7.3	DESIGN AND DEVELOPMENT				
7.3.1	Design and development planning				
7.3.2	Design and development inputs				
7.3.3	Design and development outputs				
7.3.4	Design and development review				
7.3.5	Design and development verification				
7.3.6	Design and development validation				
7.4	PURCHASING				
7.4.1	Purchasing process				
7.4.2	Purchasing information				
7.4.3	Verification of purchased product				
7.5	PRODUCTION AND SERVICE PROVISION				
7.5.1	Control of production and service provision				

7.5.2	Validation of processes for production and service provision				
7.5.3	Identification and traceability				
7.5.4	Customer property				
7.5.5	Preservation of product				
7.6	CONTROL OF MONITORING AND MEASURING EQUIPMENT				
8	**MEASUREMENT, ANALYSIS AND IMPROVEMENT**				
8.1	GENERAL				
8.2	MONITORING AND MEASUREMENT				
8.2.1	Customer satisfaction				
8.2.2	Internal audit				
8.2.3	Monitoring and measurement of processes				
8.2.4	Monitoring and measurement of product				
8.3	CONTROL OF NON-CONFORMING PRODUCTS				
8.4	ANALYSIS OF DATA				
8.5	IMPROVEMENT				
8.5.1	Continual improvement				
8.5.2	Corrective action				
8.5.3	Preventive action				

APPENDIX 8. GENERIC WEB FEEDBACK TEMPLATE

What is your feedback regarding

- ○ Agricultural services
- ○ Aviation services
- ○ Copyright
- ○ Charges and access arrangements
- ○ Climate and historical weather information, please specify type [▼]
- ○ Flood warnings and river height services
- ○ Forecasts and current weather
- ○ Hydrometeorology
- ○ Library
- ○ Linking to NMHS Webpages
- ○ Marine weather services
- ○ Ocean services (ocean currents and temperatures)
- ○ Public and media services
- ○ Publications
- ○ Radar
- ○ Registered user services
- ○ Satellite pictures
- ○ Severe weather (current), specify type [▼]
- ○ Severe weather (historical data)

For specific Web content specify URL [http://www.xxxxxxxx/]

- ○ Storm confirmation and insurance queries
- ○ Tides
- ○ Tsunami warnings
- ○ Volcanic ash advisory
- ○ Web structure and design
- ○ Weather by fax or telephone voice services
- ○ Weather maps (current)
- ○ Weather maps (historical)
- ○ Other

What below best describes you?

- ○ Aviation industry
- ○ Education institution
- ○ General public
- ○ Government organization
- ○ Hospitality industry
- ◉ Marine industry
- ○ Primary industry
- ○ Student
- ○ Tourism industry
- ○ Other

What generally best describes the content of your message?

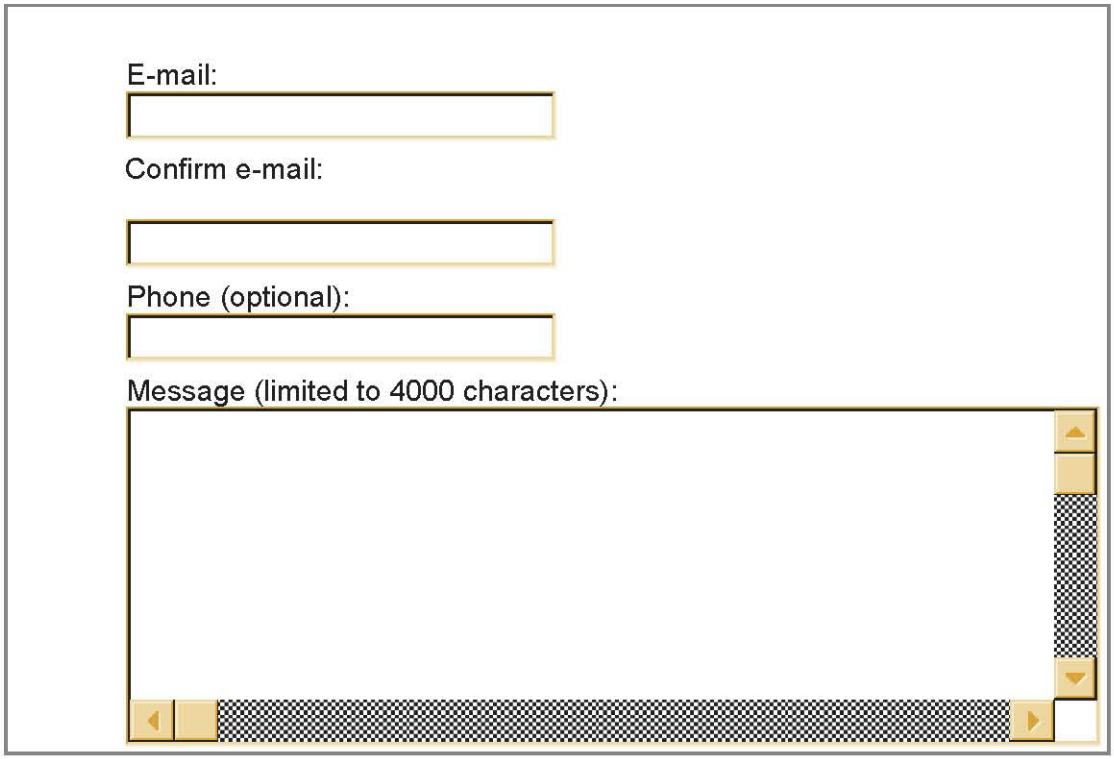
- ○ Praise
- ○ Suggestion
- ○ Request for data, forecasts or other services (note, e-mailed forecast service not available.)
- ○ None of the above
- ○ System fault
- ○ Question
- ○ Criticism

Your message relates to

- ○ A specific location. Please select location
  - ○ A
  - ○ B
  - ○ C
  - ○ D
  - ○ E
  - ○ F
  - ○ G
  - ○ H
  - ○ I
- ○ No specific location.

To ensure that we can respond to you, please provide a valid e-mail address

Name:


E-mail:
Confirm e-mail:
Phone (optional):
Message (limited to 4000 characters):

APPENDIX 9. INTERNAL AUDIT

Part A. Internal audit procedure

1 Introduction

Internal quality audits are conducted at planned intervals to determine the effective implementation and maintenance of the quality management system (QMS) and to identify potential opportunities for improvement. An internal audit flow chart summary is provided in Part B of this appendix.

2 Audit scope

This procedure will apply to all staff involved in planning, conducting and reporting outcomes of internal quality audits. The audit will encompass the defined scope of the QMS.

3 References

ISO 19011:2011, Guidelines for auditing management systems

4 Definitions

Suitably qualified auditor. Any company employee who has attended an audit skills course, and has no responsibility in the area or activity being audited.

5 Procedure

5.1 *Audit scheduling*

5.1.1 The Management Review Team shall determine the broad schedule for conducting internal audits.

5.1.2 The frequency of audits is determined by the status and importance of the activities, data collected in past audits and the action items raised in previous audits. As a minimum, an internal audit shall be conducted biennially.

5.2 *Audit performance*

5.2.1 The auditor shall prepare an internal audit checklist (see Part C of this appendix). During the audit, he/she shall be accompanied at all times by the auditee – a representative designated by the NMHS.

5.2.2 Upon completion of the audit, and where necessary, the auditor prepares an internal audit report (see Part D of this appendix) containing the following information:

- All action items;
- Objective evidence (attach if necessary);
- Any other conditions considered detrimental to normal practices;
- Any observations which in themselves would not be classified as an action item;
- Opportunities for improvement.

5.2.3 The auditor then reviews the audit report with the auditee and together they establish the following:

- The corrective action to be performed;
- The time frame for corrective action;
- The date of the follow-up audit, if appropriate.

5.2.4 The auditor and the auditee sign the internal audit report and the auditee is given a copy if corrective action is required.

5.2.5 Following completion of the audit and any further follow-up audits, the original reports and accompanying documentation are given to the relevant representative of the National Meteorological and Hydrological Service (NMHS) or to the auditee for retention and use at management review meetings.

It is essential that your auditors engage the auditee (process owner) to ensure that the audit process is a two-way view of the situation in question. Use auditing as a communication and educational tool to enable staff to gain experience across the organization.

5.3 Follow-up audits

5.3.1 When an auditor has identified an action item, a follow-up audit is conducted at an appropriate time to verify implementation of the agreed corrective action.

5.3.2 The results and acceptance status of the follow-up audit are noted in the original internal audit report.

5.3.3 In cases where there is insufficient space on the original form, an attachment may be included with the report.

5.3.4 In cases where the follow-up is not satisfactory, repeat step 5.2.3 of this procedure.

5.4 Corrective action/Follow-up format

The time taken for corrective action is monitored via the management review process.

5.5 Audit documentation

5.5.1 The auditor is responsible for maintaining all documents through appropriate management practices for the storage of records.

5.5.2 Upon acceptance of completion of the audit, the checklists, audit reports and any attachments are forwarded to the relevant NMHS representative or auditee for review.

5.5.3 The quality manager is responsible for filing the completed audits.

5.6 Audit failure

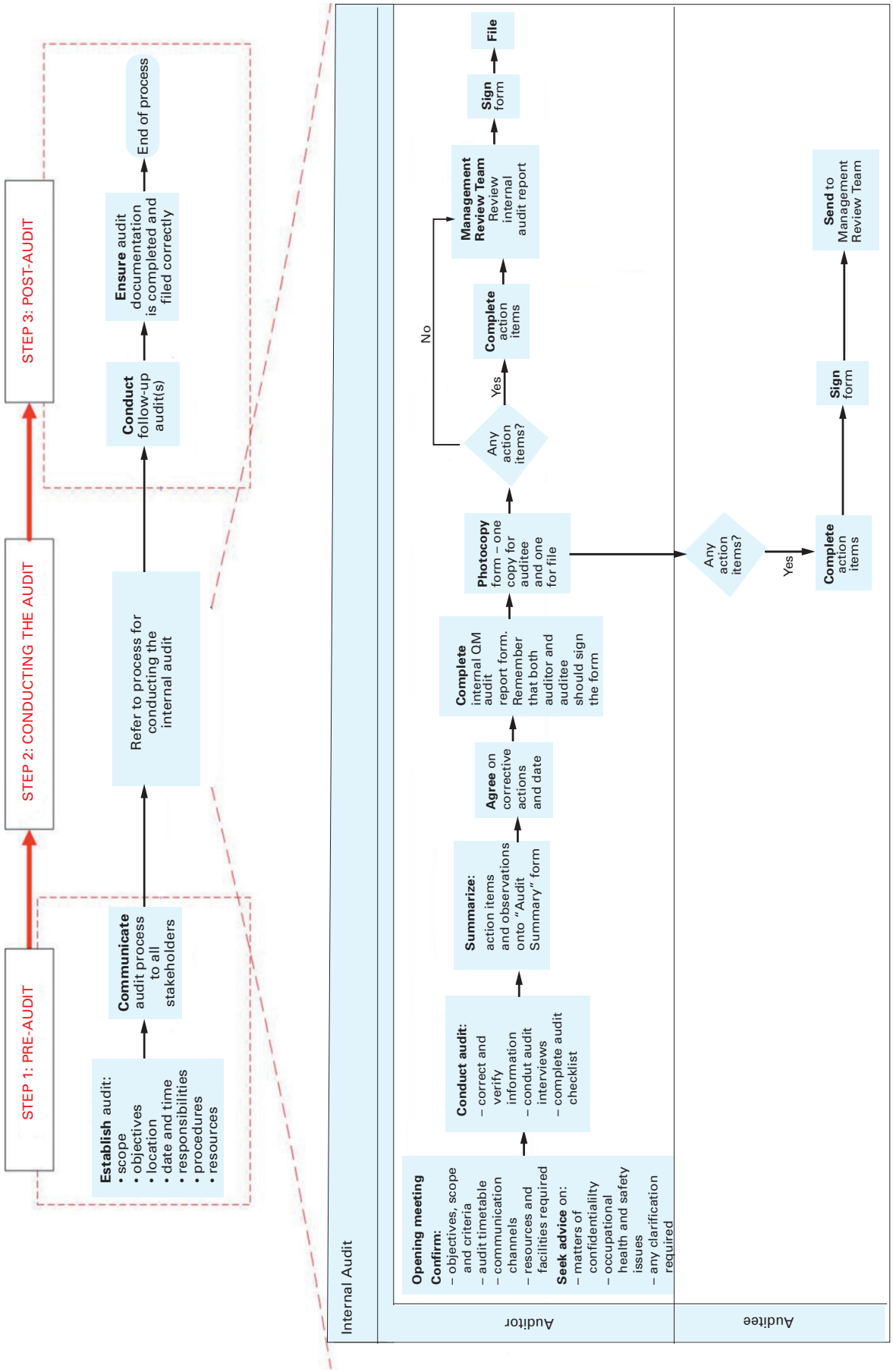
5.6.1 If, for whatever reason, an audit is terminated prematurely, the reason is to be documented and discussed with the relevant NMHS representative or auditee.

5.6.2 The relevant NMHS representative or auditee will then reschedule the audit.

5.7 Management review

All audit reports are reviewed at a subsequent management review meeting.

Part B. Quality management internal audit process



Part C. Internal audit check list

INTERNAL QUALITY MANAGEMENT AUDIT CHECKLIST

SECTION/OFFICE:

DATE:

AUDIT NUMBER:

Scope	Comments	Result

Part D. Internal audit report

INTERNAL QUALITY MANAGEMENT AUDIT REPORT

AUDIT No: AUDIT DATE: AUDIT SCOPE: AUDITOR: AUDITEE:
Action items and observations identified as per attached audit list: Number of actions: _____ Number of observations: _____
Corrective action(s) was/were agreed to be completed by the following date: __ /__ / 20__ AUDITEE: _____ (signature) AUDITOR: _____ (signature)
FOLLOW-UP COMMENTS: All action items completed: YES ☐ NO ☐
If no, provide an explanation: AUDITOR: _____ DATE: __ /__ / 20__

A: Action required **O**: Observation for suggested improvement in service

APPENDIX 10. GENERIC TEMPLATE FOR THE AGENDA/MINUTES OF A QUALITY MANAGEMENT REVIEW MEETING

QUALITY MANAGEMENT REVIEW MEETING AGENDA/MINUTES

Date:
Time (max 90 minutes):
Venue:
Attendees:
Apologies:

Meeting objectives		Required action(s)	Responsible officer(s)	Target date
To review:				
1.	The action items from previous meetings			
2.	The internal audit action items			
3.	The latest external audit and the progress on any identified non-conformities, and requirements for correction or scope for improvement associated with the audit			
4.	Client feedback both positive and negative			
5.	Forecast verification results			
6.	The status of preventive and corrective actions			
7.	Organizational changes that could affect the QMS			
8.	Recommendations for improvement of product and or service delivery			
9.	The extent to which quality objectives have been achieved			
10.	The QMS resource status			

Note: The above template is forwarded prior to the meeting to all participants. During the meeting, the form is completed as each agenda item is addressed and the resultant document becomes the minutes of that meeting. This has been found to be a very effective and efficient meeting tool.

For more information, please contact:

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