



HANDBOOK FOR IMPLEMENTING A QUALITY MANAGEMENT SYSTEM IN A NATIONAL MAPPING AGENCY

CERCO Working Group on Quality

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PREFACE

In 1997, I was charged with the setting up of CERCO Working Group on Quality. The issue of a HANDBOOK FOR IMPLEMENTING A QUALITY MANAGEMENT SYSTEM IN A NATIONAL MAPPING AGENCY was quickly identified as a key task for NMAs to produce collectively. It is thus a pleasure to see its completion. No doubt it will help NMAs of Europe in improving their efficiency, their cost effectiveness and their service to their consumers. I would like here to thank Laure Dassonville, chairwoman of CERCO WG on Quality, who took over from me, and all the WG on Quality members for the impressive work they have done.

François Salgé
Assistant to the CERCO president.

There are many reasons why European National Mapping Agencies are implementing quality management systems, but one of the most relevant is that it provides an efficient and general framework to deal with all quality issues for producing and using Geographic Information. This handbook both describes the framework and is a guideline for implementing a quality management system in a National Mapping Agency.

The contributors to this handbook are all members of NMAs. They used their practical experience to identify the main topics, and this has produced a practical model for quality management with several processes linked to data quality and to international standards for Geographic Information. I hope that this handbook will help all those who are wondering about implementing and maintaining a quality management system in the Geographic Information field.

This work was long and hard. Therefore I wish to acknowledge the experts of the CERCO Working Group on Quality, François Salgé who launched the Working Group on Quality as the first chairman, Jean Poulit the CERCO president and John Leonard, the CERCO General Secretary, who gave their support for writing this handbook.

Laure Dassonville
Chairwoman of the CERCO Working Group on Quality

Summary

After an introduction explaining the context of quality management in NMAs, this handbook contains chapters on the main topics for the CERCO Working Group on Quality. Each chapter consists of a series of questions and answers, and practical examples.

If quality of a given product is defined as its ability to satisfy customer's needs, then the measure of a **customer's satisfaction** becomes a synonymous with quality assessment. Product quality is a function of actual performance and expectations, and it has been proved that higher expectations encourages more useful feedback from customers. Geographic Information implies long term and expensive production processes. Customer satisfaction provides valuable information for saving resources by tuning those processes and its quality aspects. Therefore the measurement of customer's satisfaction should be seen as an essential part of business management and should be carefully designed as one of the key measures of the success of an organisation.

Subcontracting and partnership is a process in which more and more National Mapping Agencies are involved. These processes, in a quality management approach, have to be planned and described in a quality manner. The handbook provides guidelines for the whole process, from preparation of the tender documentation, through bid evaluation and selection, to the control of the external subcontractor and of the final delivery.

The **applicability of ISO 9000 standards to Geographic Information** is also discussed. The aim is to identify the differences with other branches and manufactured products in order to help to apply these standards to this field. As a conclusion, it is possible to use ISO 9000 standards but there are some characteristics linked to data quality (inspection and testing, non-conform products, statistics). A guideline for applying the ISO 9001, release 1994, is provided in appendix B.

Establishing a quality management system may be considered as a project with an important social component, because it implies changes to an existing culture and practices. The handbook advises that a quality management system can only be successful if top management are persuaded to take a sustained, active role in establishing it. Once they are on board, then next steps are to identify a quality manager and explain the advantages of such an approach. Then the methodology is outlined: identify a pilot project that will demonstrate benefits quickly, analyse existing processes, identify improvement sources and manage the quality management system. This chapter provides an overview for implementing a quality management system with the different topics detailed in the following chapters.

Setting up a quality management system in an NMA is a strategic operation, which implies that there are **management responsibilities**. The top management has to be convinced and committed to quality management if they are to convince all the staff of its advantages. This point is a key for success if the results are to be sustained.

Communication is a two-way process. As well as the need to gain support from top management and the staff during the launch of a quality management project, it is also important to enable staff to provide feedback on how to improve its operation. The handbook outlines several communication methods, including tools from the existing communication staff, and new tools, such as a specific newspaper about the quality project, messages on the intranet, or meetings and seminars.

Training and education are also essential for promoting and establishing a quality management system. Topics include: quality assurance, documentation, quality audits, total quality management, process management, statistics and all the methodologies for solving problems. It may be a long process so it is a good idea to firstly train quality managers and trainers who will in turn train the rest of the staff. It is very useful to use consultants and to get practical experience from other sites already experienced in quality management systems.

Controlling quality costs is a very useful way to show the worth of implementing quality management. In any environment, there will be defects occurring for one reason or another. Costs arising from these defects are termed "costs of quality". It is possible to identify four types of these costs: internal failure costs (defects discovered before shipment), external failure costs (defects discovered after shipment), appraisal costs (for assessing the condition of materials and product) and prevention costs (keeping defects from occurring in the first place). Efforts and investments to reduce failure costs have to be balanced with appraisal and prevention costs.

Quality evaluation is an important part of quality management. This measures how well a dataset meets its specification. Before evaluating, it is important to know the production processes in order to identify the critical steps to control. Then, you have to select quality parameters among those that are described within standards (lineage, positional and semantic accuracy, completeness, consistency and temporal accuracy). To measure quality you may use software, visual examination or "ground truth", you need to have a reference dataset. When a dataset has to be updated, the methodology for evaluating the quality has to be reviewed.

Documentation formalises the organisation's rules and procedures and is an essential component of a quality management system. Activities include: organising the documentation (e.g. description of the organisation, quality procedures, instructions); differentiating between quality records and quality documentation; formalising the rules and the responsibilities for managing the documentation; defining a methodology for maintaining the documentation that involves the staff. The difference between processes describing what has to be done and procedures describing how to do it has to be emphasized.

To be ready to cope with most difficult situations, it is recommended that a system of **risk management** is used. This approach involves identifying events that may occur and classifying them according to the possibility they may occur and their impact. When implementing a quality management system, the most likely risks are objections coming from top management (lack of support, increase of costs) and from the staff (too much documentation, no improvement of the quality level, conflicting rules, etc...).

All these topics are detailed with the practical experiences from the members of the CERCO Working Group on Quality. As it is a picture of the experience at a precise time, the intention is that this handbook will be improved over the coming years with other's experiences.

Foreword

CERCO (Comité Européen des Responsables de la Cartographie Officielle) gathers participants from National Mapping Agencies. It has created several working groups for exchanging information and for discussing Geographic Information issues. During its Plenary Assembly in Cyprus (22/23 September 1997), CERCO decided the creation of the Working Group on Quality (WGQ) to study problems and share experiences among National Mapping Agencies (NMAs) about quality aspects of Geographic Information. The WGQ is working on three main issues: "Quality management and ISO 9000", "Data quality issues" and "Standards" (CERCO, 1997).

The objectives of the "Quality management and ISO 9000" issue are:

- to analyse the opportunity of implementing Quality Management Systems (QMS) in NMAs;
- to develop arguments for justifying the use of QMS;
- to give arguments for certification.

Special attention is devoted to the family of standards EN-ISO 9000, as the more widely used QMS normative reference, in particular to the applicability of ISO 9000 standards to Geographic Information.

In 1999, from the answers to a specific questionnaire (CERCO, 1998), the CERCO WGQ wrote a document entitled ***"Good reasons for implementing a QMS"*** (CERCO SWGA, 1999). The objectives of this discussion were:

- to promote QMS implementation within the NMAs;
- to share common knowledge about the reasons;
- to justify the implementation of a QMS;
- to identify interesting subjects and experiences to be discussed in the field of QMS.

The CERCO 1999 Plenary directed the Working Group on Quality to produce a document that will help NMAs to implement, to maintain and to improve a quality management system. This handbook is the result and has the objectives of:

- to give a contribution from NMAs, explaining what is specific for Geographic Information and adding a value compared with existing books about quality management;
- to help QMS's managers within NMAs to start, to maintain or to improve a QMS by giving a guideline on what should be done with practical templates and examples coming from our own experiences, as the minimum for implementing such an organisation.

The document has been written thanks to the contribution of main authors belonging to the CERCO Sub Working Group "Quality management and ISO 9000" from October 1999 to June 2000; then it has been discussed and reviewed by the members of the sub-working group.

This handbook is stored on the CERCO WEB page and it will be updated from any suggestion after approval by the editing committee.

List of keywords:

Customer's satisfaction
Data quality
Geographic information
ISO 9000 standards
National Mapping Agency
Quality assurance
Quality Management System

1 Introduction

1.1 Purpose of handbook

This handbook provides guidelines for implementing a quality management system in a National Mapping Agency (NMA). It supplements the general documentation provided in the ISO 9000 standards and other publications, focussing on the needs and processes within NMAs.

1.2 Context

All organisations have management procedures and instructions for creating and delivering their products to customers. Most have evolved over many years, and are generally adequate – if they weren't, organisations would quickly go out of business. However poor management systems can lead to wasteful processes, poor products and services, and dissatisfied customers.

An efficient organisation can be characterised by:

- explicit awareness of, and concern for, the needs of customers and other stakeholders (e.g. suppliers, society, staff);
- senior and middle managers who understand and focus on business needs;
- a commitment to improve products and services;
- staff development and training programmes that meet the needs of the organisation;
- processes designed to identify and reduce wasted effort or output;
- complete, current, clear and relevant documentation.

Organisations are increasingly introducing formal quality management systems (QMS) to gain these perceived benefits. However most organisations do continue to function without a formal QMS. Generally, there are enough staff who know how the system works, how to recover from failed operations, and how to keep 'the show on the road'. Problems of waste, rework and poor customer satisfaction are hidden within the existing processes, and if there are no monitors or standards it is difficult to identify this waste. Such problems can be more entrenched when there is little incentive to show efficiencies or improve service.

A quality management system won't in itself solve an organisation's problems. But it does significantly increase the chances of identifying and removing the causes of error and waste, and thence of improving processes and information.

1.3 What is a Quality Management System ?

Definition

A Quality Management System can be seen as a complex system consisting of all the parts and components of an organisation dealing with the quality of processes and products. A QMS can be defined as the managing structure, responsibilities, procedures, processes, and management resources to implement the principles and action lines needed to achieve the quality objectives of an organisation.

There are many definitions of a QMS (ISO 8402, 1994), but most definitions don't provide any more information than the words 'quality management system'. The definition of a QMS is evolving into a definition of good management. It is not an addition to an organisation. It is an integral part of its management and production.

A good QMS does not in itself make an organisation more profitable, efficient or customer focussed, but it will give to an organisation the ability to do anything better, from production to sales.

The history of QMS systems and the associated standards has meant that until recently there was considerable emphasis on documentation. Although successful in many production and assembly-line environments, many other organisations found the emphasis on documentation detracted from what the QMS was trying to achieve. It is very easy to simply concentrate on the detail of the documentation process. However, a modern QMS is much more than this. It is a major contributor to helping an organisation focus on its goals – better service to users and customers, reduction of waste and rework, helping staff in all areas to ‘do it better’. This has been recognised by the ISO standards body, and the objectives are reflected in the new edition of the ISO 9000 standard, due to be published at the end of year 2000.

This handbook defines a QMS in two parts – its objectives, and the main components for achieving these objectives.

The **objectives** are:

- Customer focus – actively reviewing customer needs through dialogue; making customers aware of new products and services; ensuring the organisation is aware of customer needs; corrective action when the service fails to meet expectations.
- Continual improvement – of products, services, working environment, staff development, and management and production processes.
- Reduced waste – a reduction in wasted products, repeated or corrective work and unnecessary processes.

The **main components** are:

- The active and positive commitment of senior management.
- Good two-way communication throughout the organisation that encourages a culture of initiative and improvement.
- Simple, efficient monitoring systems that enable all levels of management to identify bottlenecks and waste.
- Staff development that provides the correct level of competence for each job, and provides staff with opportunities to progress.
- Documentation that supports the above.

1.4 The benefits of a QMS

In "Good reasons for implementing a QMS" (CERCO SWGA, 1999), a number of direct benefits of a QMS are stated:

- improved customer satisfaction;
- improved quality of products and services;
- workers' satisfaction and more commitment to the organisation;
- better management and a more effective organisation;
- improve relations with suppliers;
- improved promotion of corporate image.

Besides these direct benefits, there are also several indirect benefits to identify, which give opportunities to:

- review business goals, and assess how well the organisation is meeting those goals;
- identify processes that are unnecessary or inefficient, and then remove or improve them;
- review the organisational structure, clarifying managerial responsibilities;
- improve internal communication, and business and process interfaces;
- improve staff morale by identifying the importance of their output to the business, and by involving them in the review and improvement of their work.

These benefits and opportunities apply to any business. The specific benefits to NMAs can include:

- removal of non-conformance from topographic data;
- a faster registration of cadastral records; more efficient map production;
- complete and consistent land (tenure, use, cover) records;
- improved data and equipment supply management.

1.5 QMS and ISO 9000

The ISO 9000 standard (ISO 9001,1994) provides comprehensive guidance on the principles, scope and implementation of a QMS. Each NMA must decide for itself to what extent it wishes to comply with the standard. The options are:

- implement a QMS without reference to the standard;
- use the principles and concepts within the standard;
- adopt the standard and seek an ISO 9000 certificate.

Many organisations successfully adopt a QMS without an ISO 9000 certification, relying on their internal review procedures to keep the whole process on track. ISO 9000 certification leads to formal review and approval of the QMS by an outside body and, more importantly, the certification body will review the QMS every six months. Accreditation bodies are being established in a growing number of countries, sometimes with a government mandate. Certification bodies that fulfill the criteria of the accreditation system are duly accredited; relevant criteria are for instance the EN 45000 series). This independent review is very useful for identifying potential problems early, and provides an incentive to keep the QMS current and relevant.

1.6 The risks of implementing QMS

The NMAs contributing to 'Good reasons' (CERCO SWGA, 1999) have identified the main risks as :

- short-term increase in production costs during training and implementation of the QMS;
- dissatisfaction of staff because of new methodology – e.g. resistance to change and perceived risk of 'exposure';
- another set of rules and papers without actual results – e.g. documents that reflect what management think is happening, not what is happening;
- no improvement of the quality level in the final product – additional bureaucratic effort with no gain.

The risks of implementing and maintaining a QMS are now well known. Although they cannot necessarily be eliminated they can be managed, and their impact reduced. This handbook is a tool for containing these risks.

1.7 Structure of this handbook

This handbook is structured as several chapters consisting of main processes when implementing a QMS. Each chapter contains :

- a short introduction about the quality management process;
- a list of main questions about the process with answers based on the experience of the members of the CERCO working group on quality;
- a list of frequently asked questions (FAQ), as a summary of the main points to focus on with a QMS.

At the end of the document, some references are provided and several annexes provides some details about questionnaires for customer's satisfaction, ISO 9001 and Geographic Information and courses on QMS.

2 Customer's satisfaction

As quality is defined as the totality of characteristics of a product that bears on its ability to satisfy stated and implied needs, customer's satisfaction measurement appears as the most objective way of global assessment of the quality level of a given product. Customer's satisfaction is an essential measure that should have a status in corporate culture and effect until process improvements. Quality management as well as business strategies recognize the vital importance of customer's satisfaction to the success of an organisation (Ahonen, 1999).

To produce optimum quality, the best available level of quality, is not good practice because it implies high costs and slow production processes that delay delivery to customers. A better approach is to produce a sensible basic level of quality and then refine the product in response to customer's demands. Continuous improvement of a delivered product is better than spending a long time improving the quality of a potential product.

Customer's satisfaction requires contacts between the organisation and its customers. These include personal, product, support system and general contacts. Each contact creates experiences that modify the customer's expectations.

Customer's satisfaction is based on experiences and, therefore, we shall talk about satisfaction of persons. Customer's satisfaction is a function of perceived performance and expectations. In this sense it is a subjective measure.

How to define customer's satisfaction?

- ⇒ **Satisfaction is a person's feeling of pleasure or disappointment**
resulting from comparing the perceived performance of a product in relation to their expectations. If performance matches the expectations, the customer is satisfied. If performance exceeds expectations, the customer is highly satisfied or delighted. If performance falls short of expectations, the customer is dissatisfied.
- ⇒ **The satisfaction process can also be seen as comprising cognitive and emotional processes:**
 - situation - perception - emotional evaluation (by feelings)
 - use of the product - performance - cognitive evaluation (by hard facts)
- ⇒ **The level of expectations heavily influences the customer's behaviour in various situations of satisfaction**
At a low expectation level it is easy to satisfy the customer but if he is not delighted, he can easily switch supplier. If a customer with low expectations becomes dissatisfied the switch is probably unavoidable.

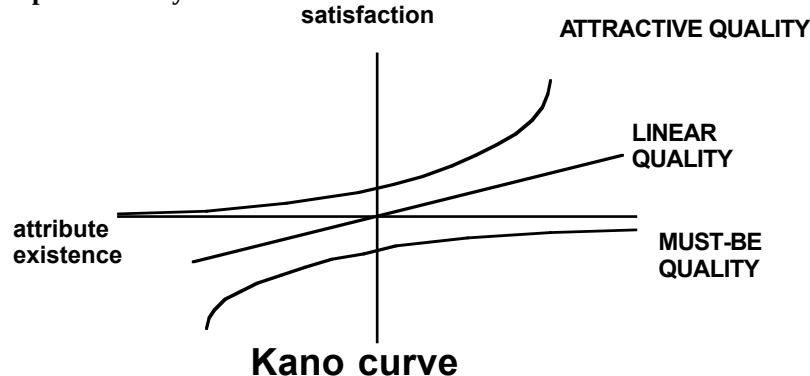
SATISFACTION EXPECTATION	LOW	MEDIUM	HIGH
LOW	Inevitable switch of supplier	Moderated loyalty	Surprise
MEDIUM	Unexpected switch of supplier	Useless complaints	Moderated loyalty
HIGH	Dissatisfaction with useful complaints	Dissatisfaction can be tolerated	Deep loyalty

Customers with an average level of expectation, and slightly dissatisfied, form a critical group because they do not actively complain, and even when they do complain it is not always easy to change the situation. This kind of customer may switch to a competitor without notice. If the customer has a high quality image of a product or organisation, the expectations are high, but they may tolerate occasional dissatisfaction. A high level of expectation, combined with high satisfaction or delight with a product, results in high customer loyalty. However, customer loyalty can also be affected by other factors, such as replacement costs and communication.

- ⇒ **An organisation can affect not only its performance but also customer's expectations**

Of course customer's expectations can affect the organisation, but the point is that organisations must be aware of their active role in creating and modifying customer's expectations. In general, the expectations depend on the branch of business, business idea, marketing communication, experiences, public image and word of mouth. The whole of the partly dependent factors is significant. The level of expectations compared to the expectation levels relating to competitors is significant rather than the absolute level.

- ⇒ **The quality management view to customer's satisfaction can be represented by the Kano Curve:**



This links quality attributes to customer's satisfaction in a dynamic way. When a quality attribute appears as must-be quality, the lack of the attribute causes dissatisfaction but its full existence causes only a neutral reaction, and further improvements of the attribute do not yield any increase in satisfaction. When it is one-dimensional (linear) quality, increase in the quality attribute causes a predictable increase in satisfaction. When it is attractive quality, the non-existent quality attribute causes no dissatisfaction since it is not expected whereas its appearance causes delight. Attractive quality attributes are sooner or later copied by competitors and they turn into must-be quality. Also the service paradox may appear: the better the service quality gets, the more dissatisfied the customers become.

What is the customer's satisfaction measurement?

- ⇒ **Consider it as a process:**
Customer's satisfaction measurement should not be an isolated add-on activity but a fixed part of management. Customer's satisfaction measurement itself is a process, which continually evolves and feeds new customer input into the organisation. Customer's satisfaction contributes to the life cycle of the product. The next release of the ISO 9001 standard focuses on customer's satisfaction in a very dynamic way, based on the process concept.
- ⇒ **Decide who is the customer:**
As Geographic Information (GI) can be used in a great number of different fields of application, it is almost impossible to produce maps or datasets fitting accurately all existing user's needs. Therefore it is necessary to decide the relative importance of different customers. In other words, an organisation must define who is its standard customer.
- ⇒ **Try to identify which elements are contributing to customer's satisfaction:**
Customer's satisfaction includes other services than the product itself: documentation, hotline, commercial contacts, assistance, delivery time, data accessibility, possibility for training,...

- ⇒ **Track of the customer's expectation:**
Customer's satisfaction management includes tracking of customer's expectations, perceived company performance and customer's satisfaction. Organisations also need to monitor their competitors' performance in these areas.
- ⇒ **Take into account the impact of time on value:**
During the product life cycle, the value may vary a lot in different phases (here the phases are purchase, usage and disposal/replacement; this is a different model than the widely adopted life cycle model of marketing management). In most cases usage is the main value-giving phase, but to some products the purchase or the disposal/replacement may give most of the value. Value functions can be used to represent the behaviour of customer's satisfaction in various phases. The conclusion is that measuring of the satisfaction is very time-sensitive.
- ⇒ **Consider it both as a goal and a marketing tool:**
For customer-centred organisations, customer's satisfaction is both a goal and a marketing tool. Companies that achieve high customer's satisfaction rating typically make sure that their target market knows it.
- ⇒ **Design the customer's satisfaction measurement process as follows:**
 - 1 Clarify the objectives of the measurement effort.
 - 2 Do a research design resulting to meaningful questions to the customer.
 - 3 Identify the attributes relevant to customers.
 - 4 Design the questionnaire and the sampling plan.
 - 5 Pre-test the measurement process before next, including testing of the questionnaire, sampling and data analysis.
 - 6 Gather data.
 - 7 Carry out the data analysis in order to reach understanding of customer's satisfaction determinants.
 - 8 Define the standard customer and revise the definition periodically.

The whole process should lead to process improvement. Otherwise it has been useless.

Which kind of tools do we have for measuring customer's satisfaction?

- ⇒ **Customer's satisfaction surveys** can be performed by using quite simple questionnaires, for example see appendix A.
- ⇒ **In addition to surveys**, other tools of measuring customer's satisfaction are (the list is not exclusive):
 - exception, complaint and suggestion handling systems;
 - ghost shopping;
 - lost customers' analysis.

How to define GI customer's satisfaction?

- ⇒ **Explain to customers that the existing quality level is achievable and provides what they need**
Generally speaking, feedback makes customers feel that their satisfaction is important for the company and that their opinion is taken into account in the design of the process. This point is particularly essential in an activity, like national cartographic production, where the tradition is to define product specifications by means of laws or other kinds of official documents without a direct input from customers.
The aim is to convince the customers that the existing quality level is achievable, and that it provides the quality they need for their applications.

- ⇒ **Include customer feedback even if the GI process production is long**
One characteristic of GI is long production times. Cartographic and geographic projects typically take more than 4 years. The problem is how to take customer feedback into account with the required flexibility in such a long term process. Reengineering is not always possible or cheap. One solution is to try to predict future customer's demands by analysing present demands and trends.

Error-handling or high-quality data?

- ⇒ **Be aware of the initial need for data at the required scale rather high quality**
For the GIS market, there is such a dramatic lack of data, that customers' first demand is to have data at the required scale, independent of its quality. Then, when errors are identified, the basic demand is for a quick and efficient response in amending errors rather than replacement with higher quality data (which is difficult for users to define anyway).
- ⇒ **Correct errors efficiently rather than attempt to reduce the number of errors to almost zero**
Geographic Information, because of its volume, has always some residual percentage of errors. Therefore the idea of correcting detected errors efficiently is more realistic than reducing the number of errors until nobody can find them.
This approach, not obvious at first sight, of "quick response" more than "high quality", reflects customer feedback for many NMAs.
- ⇒ **Implement a well-designed production and a maintenance process**
The above mentioned tools of exception, complaint and suggestion handling systems, notify organisations of improvement possibilities, in order to avoid complaints and resulting error-handling. Such improvements can only be introduced if the organisation has well-designed production and maintenance processes.

How to manage customer's satisfaction?

- ⇒ **Install a service desk:**
Set up a unit inside the marketing department of the organisation which can be reached directly by every customer with complaints about a product, questions about new releases, remarks on bills etc.... This service desk must be constantly be available for customers to ask, complain, remark at any time. This will demonstrate that the organisation is really interested in the customers and their organisation needs.
- ⇒ **Set up a back-office for the service desk:**
The service desk staff give answers, accept remarks, handles complaints. However they need access to other staff in the organisation when their own knowledge is insufficient. This back-office can cover a large part or even the whole of the organisation.
- ⇒ **Install a software tool to support the work of the service desk:**
Just having a constantly manned telephone, fax or e-mail is not enough for managing the satisfaction of the customer. A range of proprietary software tools are available to keep track of what has been done with remarks, if questions have been answered and what the answers were, to whom the question is forwarded, etc....

⇒ **Identify trends in remarks, questions, complaints, etc...and manage the satisfaction of the customer:**

By keeping a record of all incoming and outgoing remarks, questions, and answers, you can identify what your customer really wants, even before he asks explicitly for a new product or an adjustment to an existing one. Take advantage of it!

Frequently Asked Questions :

- *How can I measure the satisfaction of the users?*
By designing a customer's satisfaction measurement process based on questionnaires, interviews, recording complaints and suggestions, ghost shopping, lost customer's analysis.
- *How can I foresee future requirements?*
By identifying present requirements and trends as soon as they emerge.
- *Is there any difference between short- and long-term GI customer's satisfaction?*
Sometimes customer's satisfaction is very time-sensitive and may vary a lot depending on the phase: purchase, usage and disposal/replacement).
- *How can I use knowledge of customer's satisfaction to design new products?*
Knowing customer's satisfaction in detail enables the identification of the most appreciated characteristics of a cartographic product.
- *Is customer's satisfaction for GI customers different from other business and its customers?*
There are some specifics:
 - Customer's satisfaction is specially relevant in the field of GI because traditionally official cartographic products have been defined by law or regulations without taking into account user's point of view.
 - GI implies huge volume of data and long production processes. This makes more difficult reengineering processes because of new customer's requirements.
 - GI implies long and very expensive production processes. To know accurately customer's requirements about quality save a lot of money and resources by concentrating efforts in making the corrections customers actually need.

3 Partnership and subcontracting

More and more European National Mapping Agencies are creating partnerships with external contractors. Describing and planning the associated processes within a quality management system helps achieve the desired results.

Introducing partnership and subcontracting causes problems, dilemmas and questions about ensuring the product's quality, especially if the entire production has been developed by the NMA's own resources over many years.

The basic characteristics of public contracts are similar in all systems, and comprise:

- *stated needs of service or product,*
- *need for economy and efficiency,*
- *equal opportunities for all potential bidders to participate in the invitations to tender, whether in a production task or consultancy. All bidders are in equal position in respect to set up criteria and conditions. To achieve comparability among bidders the tender documentation should ensure each bidder can assess the significance of each condition and evaluation criteria. This ensures the comparison of tenders is fair and conforms to any national procurement procedures.*
- *to provide transparency and to make the procurement process public. All important facts in the public procurement procedure should be published and the contracting authority must ensure all interested parties are acquainted with these facts.*

Commissioning work through public procurement starts with correct and detailed planning of the entire project – the commissioning strategy, performance of all procurement steps, the work itself, and control of the product. Full and detailed planning is the basis for realising the objectives of producing a quality product.

How to prepare the tender documentation?

When commissioning work by external contractors, it is necessary to define, specify and describe the products accurately and precisely. The main issues include preparing the invitations to tender that ensures selection of the appropriate contractor, controlling the contractor and determining the results that will lead to a quality product.

⇒ **Sample tender documentation:**

In the field of public procurement and subsidiary regulations, it is possible to establish sample tender documentation for particular types of invitations to tender, and to define recommended methods to select bidders. These are the basis for preparing and implementing each invitation to tender, and they facilitate work for all who prepare them (this only applies where the national public procurement system does not regulate these samples).

⇒ **Definition of final product:**

Besides the economic and legal section of the tender documentation, the technical section is of utmost importance, wherein the final product and the required quality are accurately defined.

⇒ **Enclose the contracting authority's product sampling:**

If this is possible it should be a complete and exact representation of the product being commissioned.

⇒ **Define accurately evaluation criteria in the tender documentation:**

Besides pricing criteria there can also be others (non-pricing) - for example references of both the company and their personnel, a description of the tenderer's approach to the work, etc. The tender documentation must define the importance of each evaluation criterion and sub-criterion. The contracting authority appoints an evaluation committee for the selection of the contractor.

⇒ **State clearly the contracting authority's requests:**

The bidders must demonstrate they are qualified to implement work. Evaluation criteria will clarify the objectives – for example to implement work, the bidder should fulfill:

- financial requirements, e.g. minimum annual turnover and cash flow the bidder should comply with;
- technical requirements, e.g. years of experience in the tendered field of work - of the company as well as of individuals,
- contents – production requirements, e.g. a schedule of required equipment to implement work, list of contracts in a similar field of work, requirements to implement substantially similar contracts of a fixed value in a definite period of time.

How to find out in the selection phase whether the bidder is qualified to perform work?

⇒ **Request references:**

The bidder should provide relevant references (references should refer to the company, as well as to key persons).

⇒ **Enclose product sampling:**

The bidder should provide samples of the product which he would submit if he was selected as the contractor.

⇒ **Set up the requirements the bidders should fulfill already in the tender documentation:**

For instance, personnel requirements, financial requirements (bidder's financial condition and aptitude), bidder's production capacities, and similar.

How to assure the contract work?

The contract work assurance is possible by means of bank guarantees, bills, and similar. The purpose of the assurance is to assure the risk not to have the contract signed, the advance risk, the risk not to have the contract work performed as agreed, and the risk not to eliminate the contract work errors.

⇒ **Bank guarantees:**

Bid security guarantee, advance repayment guarantee, performance guarantee, errors elimination guarantee.

⇒ **The system of payment:**

The method of payment can substitute some guarantees.

How to define relations between the contracting authority and the contractor?

There are many types of contractual relations between the contracting authority (purchaser) and contractors. International procurement rules (e.g. the European Union Directives, World Bank procedures) permit a range of different contractual relationships. Contractors can act individually, or they can form different associations – from joint-ventures with equal partners to one contractor with one or more subcontractors. Whichever method is used, their respective liabilities must be fully defined. Irrespective of the arrangements between contractors the "outward liability" should be clear and unequivocal. However, the contracting authority (purchaser) should also be acquainted with the "inward liability", particularly with joint venture mergers for production tasks.

⇒ **To follow up the contract work implementation:**

the preparatory phase should include a detailed implementation plan.

⇒ **To define responsibilities and liabilities accurately in the contract:**

to nominate contract agents who will resolve any problems that occur during the implementation, supervise the production work, and carry out or organise any revision (entire or sample review option) to ensure the specification is met.

- ⇒ **A written communication:**
It is good practice to communicate between the contracting authority (purchaser) and the contractor in writing. This provides a permanent report system on the condition of the project.
- ⇒ **Permanent contacts and monitoring the contractor's work:**
Monitoring visits and contacts between the contracting authority and the contractor impact on the final product to a great extent, especially if the task is of a development nature. It is the duty of the purchaser's contract agent to monitor the implementation with regular reports (weekly or monthly) and formal visits to control the implementation in the contractor's premises or at the work-site.

How to control the external contractor?

- ⇒ **By good project plan preparation:**
it is possible in the planning phase to foresee the external contractor control points.
- ⇒ **By good technical preparation:**
technical instructions and standards.
- ⇒ **By supervisory plan preparation:**
being already included in the invitation for tenders.
- ⇒ **Through the contractors quality (control) plan:**
contractor should be asked to define a quality plan, stipulating what controls will be carried out at each stage of the work, who is responsible and what actions will be taken if the control is below specification

How to check up the delivered work quality?

- ⇒ **implement quality assessment within the contracting authority:**
either final or intermediary assessment (automatic assessment for digital data is recommended).
- ⇒ **use an independent contractor to assess quality:**
by using an independent contractor who has not carried out the data acquisition. Such controls implementation is reasonable in definite periods of time, or by concluded greater data acquisitions, respectively.
- ⇒ **Check the acquired data through product application:**
Many errors are discovered only by the regular data application. Therefore the use of the acquired data and products in new and existing applications is an effective quality assessment supplementing the above.

Frequently Asked Questions:

- *Public procurement types – is it reasonable to think about one single procurement method which would be developed under the patronage of CERCO ?*
Each country regulates public procurement by legislation; therefore, a single method (with single instructions and forms) cannot be introduced. However CERCO members will benefit from an exchange of experience among different systems, perhaps even by an exchange of instructions and forms sampling.

- *How to develop market?*

The fundamental condition for an effective public procurement implementation is a good knowledge of the merchandise or service market being contracted. To make the market really function, and especially if there is no great competition when dealing with specialised works (such as surveying and mapping in the majority of countries), promote international competition through international invitations to tender.

- *How to define the product value ?*

The contracting authority (purchaser) must look for the optimal solution between the product price and quality – increases in the product quality increase will lead to similar increases in the product price.

Assistance in defining the value of the product can come from previously implemented pilot projects. It is reasonable (naturally, if the national legislation allows it) that the contract value is the contracting authority's business secret.

4 ISO 9000 AND GEOGRAPHIC INFORMATION

The principles of ISO 9000 are applicable to any organisation. However it can be difficult for some organisations, including NMAs, to implement these principles when much of the knowledge and expertise is held only in the heads of 'experts'. The new version of the ISO 9000 series recognises this and moves the emphasis from documenting all procedures to ensuring the qualification and training of personnel.

What are the differences between NMAs and other institutions?

In most cases it is possible to adapt the ISO 9000 standards to the needs of NMAs. However in many countries there are differences between NMAs and the private sector. For example:

- ⇒ **Many NMA operations are defined and prescribed by detailed government legislation.**
- ⇒ **Some NMAs produce all their products by subcontracting**
and some produce them by themselves.
- ⇒ **The financial and organisation structure differs with other branches:**
Most of NMAs are still 100% financed by the government. In most of NMAs, the organisation structure is still hierarchical based on function (e.g. survey, cartography, printing) rather than project-based.

What is specific to producing GI products?

- ⇒ **In many countries the NMAs is the co-ordinator of the GI infrastructure**
:
this helps to ensure other institutions do not produce redundant data sets. Therefore NMAs have a special responsibility to ensure they produce GI products that meet society's needs.
- ⇒ **The GI products are used in a wide range of situations from the military to civil use.**
- ⇒ **The different GI products may be produced by a variety of different companies, each with quite different quality strengths and weaknesses.**

What are the specific aspects of the application of QMS ideas in the field of Geographic information?

- ⇒ **Some properties of Geographic information are essential:**
Some basic features make the management of Geographic Information different from other kinds of information:
 - GI implies a huge volume of data, due to the fact that every transaction or elementary operation (for example the generation, modification or deletion of a road) affects a lot of records, coordinates and attributes;
 - GI is fractal, and therefore very simple geometric properties, such as the length of the coastline, depend on the chosen scale;
 - GI is fuzzy, because it is modeling a part of the physical world, composed of actual rivers, mountains and so on, and not a cultural abstraction defined by human beings, such as a bank account. Therefore the represented phenomena are not standardized in any sense and have fuzzy borders. For example: where is the border of a forest? where are the precise beginning and ending of a mountain chain? is a cape a point, a line or a surface?
 - GI is very dynamic, due to the rate of change in roads, bridges, tunnels, dams, cities, buildings,...

- Every set or sub-set of Geographic Information is unique. This differs from a lot of manufactured products and illustrates the difficulty in defining specifications or using statistics to assess quality.

These properties ensure that geographic data usually contains errors that are difficult to eliminate, but which give a significant number of defaults due to the huge volume of data.

The huge volume of data implied causes also long production processes. Four or five years is a sensible period to produce a dataset covering a country at a medium scale (1:25,000 or 1:50,000) or a dataset covering a smaller area at a bigger scale (1:1,000 to 1:5,000). Reengineering a dataset to an enhanced specification is also complex and takes a long time, and it is therefore difficult to maintain the homogeneity of a product when the producer is trying to meet evolving user requirements.

⇒ **The production processes has specific characteristics**

The production of cartography and geographic datasets is often described as a mixture of technology, art and craftsmanship. Some tasks are not easily formalized and have fuzzy and subjective aspects. This activity has an artistic element because of its objective: to portray and present the information to the human eye in order that it is perceived and understood as quickly and efficiently as possible (this is why maps have been hung on walls as a decoration for ages.)

Which answer do you have to give to the chapters of ISO 9000?

⇒ **Use the guidelines provided by ISO 9004:2000 to write a quality manual:**

There are very few points which are specific to Geographic Information and you may apply the same requirements as for another product. See the recommendations of the appendix B for more information on interpreting the ISO 9001: 1994 standards (note: this Appendix will be upgraded once ISO 9000: 2000 is published).

Frequently Asked Questions :

- *Is there any difference in implementing a QMS in the GI field ?*

There is no difference in the principles for any organisation or products. However, some characteristics of GI require specific answers to the ISO 9000 requirements :

- As it is not easy to formalize some cartographic processes, the emphasis needs to be on ensuring people are trained with the right skills.

- The fuzziness, the large quantity of complex data, the geometric aspects and the fact that each GI dataset is unique all imply specific answers to some chapters of the standard : process control, inspection and testing, control of non-conform products, statistics. See chapter 10 Quality evaluation to find some solutions.

- *What will the new release of ISO 9001 imply for existing QMS?*

The new release of ISO 9001 focuses on customer's satisfaction and processes. It requires less documentation and a more significant QMS, with an actual commitment for continuous improvement. Initially it will cause major changes, but each organisation that has already implemented ISO 9000 will need to progressively modify its QMS, with emphasis on processes rather than procedures and documentation. This will simplify the quality documentation, improving the efficiency of the QMS itself.

5 Establishing the implementation

This chapter outlines the main stages for establishing a QMS. It is not a simple process. It implies change, and most people are resistant to change, particularly if it means more work in the short term just to get it started. It may also mean a change of culture. A QMS is a key factor in changing the culture and attitude of an organisation to support changes to business and to customer focus, etc. However if it is to be effective the QMS also needs other initiatives (e.g. organisation change, staff development, incentives and benefits, improved communication and feedback) that help to change the culture.

How to get the idea of a QMS fully accepted in the organisation?

⇒ Get top management on board

How? Show them the business advantages – efficiency; accountability; improved products; change management.

How? Visit other organisations – commercial and government. Show them inefficiencies and inadequacies in their own organisation (but not too publicly!)

How? Once they've endorsed the principle, prepare a business case showing costs and likely savings over 3-5 years, and the non-costed benefits. Show the issues and risks, and indicate how, as with any other business initiative they can be controlled.

⇒ On board means:

they understand it; they support it; they will set and monitor objectives; they will produce and publicise a quality policy; they will assign money and resources to build and maintain it; they will actively promote it to staff; they will reward initiative; they will seek progress reports against planned implementation.

If the top management is hesitating, how to persuade it?

⇒ Let the top management get its questions by a pre-study:

A necessary prerequisite for success is that the top management is on board, fully supporting the development and implementation of the QMS. If the top management is hesitating, perhaps a pre-study throwing light upon the consequences can be a good idea (Wikström, 1999), (Haussteiner, 1999). The top management should formulate the questions for the pre-study to answer.

An example of a list of questions can include:

- How will the future requirements of the quality of products and services develop?
- How will customers ask for proof of our quality system? Will similarly an environmental management system be demanded?
- Will NMAs in sub-contracting or as a sub-contractor influence the need for a QMS?
- How is our present quality status? How is it documented?
- Do we have internal experience of QMS? Do we find examples of success or fail among similar organisations (e.g. CERCO NMAs)?
- How do we today cope with process control and improvement work? Experiences? How will a QMS change this?
- How large is our non-quality and what are the costs? How do we monitor and improve this today? How will a QMS influence?
- Is there any benefit of including environmental aspects if we go for a process oriented QMS?
- What are the options of quality models/systems? ISO 9001:2000 or a Quality Award? Will a certification be a benefit?
- How can a QMS project be organised within the NMA? Resources/timetables? How must the work be co-ordinated between departments? How large will the investment be?

- How will a QMS in place influence the business results? How will the investment be paid off?
- How will the managers' and employees' satisfaction be influenced by a QMS?
- How will the government's, politicians' and customers' image of the NMA be changed by a QMS?

What are the different steps for the implementation?

⇒ Get the quality manager in place.

His role is to design and manage the implementation of the quality policy.

He will:

-co-ordinate the implementation program which will comprise a range of projects managed by the individual sections within the organisation;

-cajole and persuade middle managers to set realistic timescales for completing their bits of the QMS, and badger them until they have met the requirements of the QMS;

-ensure, through a team of internal auditors, that each component of the QMS meets the required standards;

-report progress, costs and issues to top management.

His personal objective should be to work himself out of a job as quickly as possible. Once the QMS is running, however imperfectly, responsibility should be reflected in the personal objectives of management at all levels.

⇒ Plan the implementation

The organisation will be looking for quick gains –i.e. where the procedures are already in place, and either there is already some monitoring of non-conformance or it will be easy to introduce. Ordnance Survey chose the Map Printing section, and was able to quickly develop a comprehensive QMS for that section with little additional work. This gave OS confidence in the process.

For each area, work through what is required – scope; promotion; training; participation; documentation; review and revision.

Identify who will take the lead in each part, and use project management principles to identify the activities, timescale and resources. Don't take too long doing this!

⇒ Analyse the existing processes:

Top down: senior management will outline the main business processes – production; supply; distribution; marketing.

Bottom up: team leaders and production units will identify their processes and relate them to the 'top down analysis'.

Define the main processes - what comes in, what do we do, what goes out, what do we do when the output isn't suitable. Liaise with your internal customers and suppliers, progressively ensuring your outputs match their inputs, especially when there is non-conformance.

⇒ **Identify improvement sources**

Get staff to identify where they think processes can be improved, particularly for when things go wrong. Involve existing quality control staff where appropriate. Congratulations, you are holding your first 'quality improvement circle'. Record the findings, find out how the improvements can be done (may effect other areas) and initiate changes. They may take some time, so in the meantime record what happens now. This can be a checklist for recording the activity, and a template for recording non-conformance, actions taken to remove non-conformance, and actions taken to prevent non-conformance.

Review these checklists and templates. Congratulations you are holding your second 'quality improvement circle'!

⇒ **Manage the QMS itself**

A QMS tends to create its own documentation industry. This is bad for moral, and the QMS will quickly lose credibility.

The analysis will not be perfect, some documentation will be unnecessary and other items will quickly become out-of-date. Remove these quickly – review documents periodically, starting with the assumption it is not required. If its existence is justified, review the scope, content and clarity. If it's taking too long to review and revise, it's probably implying the process it's describing can be improved.

If documents are too prescriptive, change the philosophy, emphasising competence and empowerment rather than detailed routines. Ensure those who have to use the procedure are involved in its definition and review – that they own it.

If staff are completing templates 'because the QMS says so', change it (the recent problems at the Sellafield nuclear re-processing plant are an example of this symptom of poor management).

Establish a small quality audit team to provide an independent view of the efficiency of the audit.

6 Management responsibilities

Setting a quality management system in a NMA is a very strategic operation, which has to be sustained by the top management. The top management has to be convinced for committing the quality management approach in order to convince all the staff to be implied also. Such an important change is a challenge which requires a lot of discussions and explanations from a social point of view to reach the expected success (Mercier,1999).

Why top management is a key to implement a QMS?

- ⇒ **Changeover dynamics:**
Implement a QMS is a changeover for the organisation. It concerns almost every sector of a NMA. It will come up against habits and resistances. The team in charge of the implementation of the QMS needs the support of the very top of the management.
- ⇒ **One of the demands of the ISO standard:**
The ISO standard describes the specific role of the management in the QMS. It is the first chapter of the ISO 9001 standard (ISO 9001, 1994).
- ⇒ **A strategic decision:**
Implementing a QMS involves investments and resources over a long time.
All the elements listed above show that implementing a QMS is a strategic decision.
So this decision depends on top management and it has to be actively supported by the managing director of the NMA.

How top management should be involved in initiation of a QMS?

- ⇒ **Pilot project**
To implement a pilot QMS in one department can be an useful way of understanding and demonstrating the benefits and pitfalls of a full QMS.
It limits investments at the beginning and provides experience for extending the QMS throughout an organisation.
- ⇒ **Commitment act**
The quality manager should be empowered by, and directly responsible to, the managing director. This should be formalized in a commitment act for quality policy, signed by the managing director and widely distributed throughout the NMA.

How should top management be involved in preparing for a QMS?

- ⇒ **Education**
Top management needs to be educated in the principles and attitudes that they need to demonstrate, for improvement of quality, but without becoming specialists in the ISO 9000 standards.
If ISO 9000 standard is the reference, they have to know the principles of the standard, the main vocabulary, and the common language of quality.
- ⇒ **Quality aims**
Quality aims have to be defined clearly. The managers must define the objectives and scope of the QMS for the activities for which they are responsible.

How should top management be involved in implementing of a QMS?

- ⇒ **Integrating quality and operational aims**
Top management has to be judged on the impact of quality management on commercial and production objectives. Therefore these objectives must be explicit.
- ⇒ **Setting an example**
Personal commitment of the top management has to be demonstrated with concrete actions.
For example, they can ask an internal quality audit on their sector of activity to show the transparency they demand to their staff.
- ⇒ **Management reviews**
The quality policy has to be clear and has to live. At the level of top management, management reviews are the elements of quality policy's life.

Frequently Asked Questions :

- *How to convince top management to implement a QMS?*
Measure some non-quality costs and show them that it is in their interest to introduce quality management. Explain the risk of losing customers who are not satisfied.
Start with a pilot department in order to test the QMS and to get experience.
- *What is the meaning of the commitment of the top management?*
This commitment in quality means that the top management has to define quality objectives; then it has to organize quality reviews to analyse regularly the results and to define corrective actions for continuous improvement. Top management has to show by itself that it is daily working in a quality management manner on very practical cases.

7 Communication

Nowadays it is a standard procedure to consider “communication” as an integral part of each project, especially when such a project can be seen to some extent as a threat to people inside an organisation. The implementation of a QMS is such a project. It affects the work and environment of every person inside a NMA. A communication plan will establish a useful dialog between people that will help to reduce staff concerns. It both enables management to explain what the QMS is about and how it will affect staff, and allows staff to voice and discuss their concerns.

Communication is related to management responsibilities and risk management, and the staff feedback improves the effectiveness of the implementation of the QMS.

Communication is a two way process: setting up an action to get reaction. The aim of the reaction depends on the group you are communicating with. Three groups can be distinguished:

- ♣ people who take part directly in the process – they are a part of the working group or project team. Communication with this group informs everyone about the status of the work, the reports of meetings, work, what’s coming up etc. Feedback enables this group to identify and resolve issues as they arise.
- ♣ the management of the NMA. As said before, these are the people who have to be convinced of the necessity of a QMS. Communication mainly informs them of the progress of the implementation or the results of audits. Their feedback should provide encouragement, and possibly identify and resolve any major issues.
- ♣ the rest of the organisation. Firstly, to keep everyone informed about the status of the work that has been done to reach a higher level of quality or to keep it that high. Secondly, to make people aware that most of the work that has to be done has to be done by themselves. Therefore it is important to give good reasons and simple hints to earn everybody’s co-operation to reach that goal. Their feedback tells the project team and management how successful the process is. Many issues can be resolved quickly if the feedback is carefully analysed and acted on quickly.

What are the different communication tools?

⇒ Briefings:

Ideal for recording progress to managers and to staff. Keep them short and to the point. Get the message over, record any questions or criticisms, give feedback on these by an agreed time.

⇒ Office notices/in-house magazine:

record progress, staff concerns, ideas and initiatives. Keep them simple, but if possible add some colour or graphics to give them impact. They need both substance and style. Always include a contact name or number for feedback.

How to initiate communication?

⇒ Persuade management:

visits to other sites; visits from other NMAs; presentations on what QMS is, what it offers, what the risks are.

How to prepare it?

⇒ Management signature:

Once management is ‘signed up’ to the concept, make it clear what they can expect, and what they must do to support it; they must brief staff, seek reviews, report progress, praise, possibly even reward, those who take the lead.

⇒ Brief all staff on the benefits:

what they will gain, what the organisation will gain, what customers will gain. Make sure they know (a) it’s mandatory (b) jobs may change but are not at risk (c) yes it is extra effort.

⇒ **Reward/award:**

Introduce some sort of reward/award for initiative and support. Money is ideal, but if that's not possible, then a simple gift (pen, mug, mouse etc.). Anything that increases awareness and peer pressure.

How to implement it?

⇒ **Keep everyone informed on how the progress:**

what's been achieved, what we're aiming for in the next one month, three months, and who's doing it. Inform through team briefings, office notices, wall notices.

⇒ **Feedback:**

Communication is a two-way process. Encourage staff to comment and criticise. Many will be negative to start with, but persistence will bring them round, particularly if their ideas are taken on board.

How to maintain it?

⇒ **Keep people informed:**

about the timing and results of audits, remind them of what they need to do before during and after an audit, whether internal or external.

Once the QMS is running, show where there have been benefits.

About successes and failures (better to inform officially than to let the rumour machine mis-inform staff).

⇒ **Be careful with potential complexity:**

Ensure the reviews of documents, but aim to keep the meetings and the work short and simple, by encouraging people to prepare for the meetings.

Frequently Asked Questions :

- *Is communication different when implementing the QMS and when maintaining it ?*

It is quite similar, but during the step of the implementation you have to convince all people about the advantages of such a project. When the QMS is established you have to maintain the motivation.

- *Which kind of messages do you have to communicate?*

Explain quality concepts very shortly with understandable definitions (quality, quality assurance, non quality, quality audits, etc). Provide information about quality management within other companies (CERCO NMAS, for instance). Give information about progress and success. Include interviews of people implied in the QMS.

- *How to communicate these messages?*

Use the ways available within your NMA -communication staff and tools. You may create a short newspaper, use the Intranet, boards or organize meetings and seminars.

8 Education and training

NMAs must recognise that **training** is a “basic factor” in achieving their business objectives when they decide to improve business performance, exchange information and initiate teamwork. Remaining competitive today happens by creating positive change through innovation and excellence. Being open to change means being able to see the whole system and to be open to different points of view as they explore together how to improve the system and meet business objectives.

Implementing a Quality Management System means introducing a new set of tools that give an organisation the ability to do things better. The organisation must learn how to use this new set of tools through education and training.

Another reason for spending time and money on education and training is that the introduction of a QMS is more complex than, say, the introduction of a new production line. It is the introduction of principles of continuous improvement which enables the whole organisation (from top manager to doorkeeper) to break through old patterns and create new ones. Education and training are significant stimulating factors for changing an organisation's culture and achieving the benefits of a QMS.

What type of education and training courses have to be included?

⇒ Courses in:

flowline and process analysis, document writing, document management, configuration management, written and oral presentation, meeting management, quality audit, project management.

Seminars on statistical process control or statistical data control. This must include sessions specific to GI as many GI-related processes do not relate to standard statistical methods for quality control (cf. ISO 7873, ISO 7870, ISO 7966, ISO 8258).

Training in calibration, particularly for optico-mechanic equipment that is periodically calibrated, and for special hardware and software products (e.g. digital workstations, scanners, automatic correlators) which don't have a specific method to be calibrated.

⇒ Seminars on:

business management, business processes, understanding workflow, flowline and data analysis, improving communication. Properly handled, these can encourage management and staff to move towards a customer-oriented culture.

Appendix C provides an example of the content of such courses.

How to facilitate and demonstrate understanding?

⇒ Use consultants to facilitate:

QMS consultants can help with the planning and identifying issues, and can give an independent view of methods and progress.

⇒ To get practical experience:

Visits to other sites, and visits from those who have implemented QMS already.

Identify the core people from all levels and departments that are going to take the lead. Give them time out to get training and experience.

How to prepare it?

- ⇒ **Appoint a small team to manage training:**
both for implementing QMS, and to co-ordinate all other types of training as the QMS expands and matures.
- ⇒ **Train:**
The trainers in the above courses, for QMS.
Educate senior and middle management.
Staff in document production, management and review.
- ⇒ **Raise awareness**
of the move from production to meeting customer needs.

How to implement and how to maintain it?

- ⇒ **Use feedback results:**
to enhance training program.
- ⇒ **Use staff:**
to train/educate others; it reinforces their knowledge and understanding.

Frequently Asked Questions :

- *Which kind of courses and seminars in quality are required?*
See appendix C for example topics and content. The numbers of days are just an indication and you may combine several topics to build one course.
- *Who will provide them?*
Send quality managers outside to be trained (this is also an opportunity to meet quality managers from other companies) or invite consultants at your NMA in order to train together your quality managers. Then ask them to train the rest of the staff.
- *Who will attend them (all the staff or only quality managers)?*
Train hard your first quality trainers and quality managers (use the appendix C to know how many days they need for each topic).
Ask them to re-produce the courses in order to train all the other quality managers.
Then invite all the staff to a one-day training for quality. You may organise a special day for the top management (it is also an opportunity to convince them).

9 Controlling quality costs

Monitoring quality costs is essential when implementing a quality management system as this gives relevant information about the balance between efforts and investments in quality to reduce non quality and what remaining non quality still costs. However it is difficult to identify all the relevant elements that should be included: some non-quality costs are hidden (e.g. useless processes within the "ghost factory") and some benefits of quality may be unmeasurable (e.g. improvement in the organisation and the responsibilities). In spite of these difficulties, quality indicators are necessary because they provide a concrete tool to measure how the QMS is improving the organisations's efficiency and effectiveness.

Defects occur for one reason or another in any environment. Costs arising from these defects are termed "costs of quality". It is possible to identify four types of these costs: internal failure costs (defects discovered before shipment), external failure costs (defects discovered after shipment), appraisal costs (the effort in assessing the condition of materials and product) and prevention costs (keeping defects from occurring in the first place).

Typically, the costs associated with failure (detection) are greater than those relating to prevention and appraisal. A QMS is an investment in these latter elements (appraisal and prevention) in an attempt to reduce the costs associated with failure - and hence the overall "costs of quality". However, it is not a simple equation and (as ever) a balance must be found between the two types of costs.

Which elements do quality costs include?

⇒ Quality costs may be divided into two parts:

- 1 Investments or conformity costs including expenditure for reducing non-quality (training, writing quality documentation,...).
- 2 Non quality costs corresponding to quality defects.

The distinction between these two kinds of quality costs provide an effective tool to analyse the impact of quality investments on defect reduction: the goal is to identify the relationship between one cause and its effects: expenditure linked to defects and the investment to reduce them.

⇒ Define how far you want to go with investments to improve quality?

You must be aware that it is not reasonable to focus on one hundred percent quality. It just takes too much effort and money. It is better, from both a production and a customer point of view, to correct errors rather than to try and reduce the amount of errors to zero (see also chapter 2 Customer's satisfaction).

What are the conformity cost indicators?

⇒ Conformity costs include costs for prevention and costs for detecting problems.

Prevention costs include: wages for quality managers and the quality project (ISO 9000 projects, for instance), costs for training, information about quality, time spent by quality working groups, writing quality documentation (processes analysis, procedures, quality manual and plans, product specifications, ...), quality audits, preventive maintenance, quality evaluation of suppliers.

Detection costs include: quality inspection costs, suppliers' costs for inspection procedures (equipment), calibration costs.

What are the non quality costs indicators?

⇒ Non quality costs include costs for internal defects (happening inside the organisation) and for external defects (happening at the customers).

Internal costs include: production delays and stops, re-processes of the product, working accidents, corrective actions, maintenance operations after a break of the production, unemployable supplies.

External costs include: handling customers' claims, delay penalties, additional bank-charges.

How to collect these costs?

- ⇒ **Identify people**
who are directly responsible for managing these costs: the closer you are to the cost, the easier it will be to collect them.
- ⇒ **Use automatic counting as much as possible**
analytic accountancy reduces effort and errors.
- ⇒ **Use electronic forms**
to be completed regularly by staff. Summarise the results in a simple chart that is easy to understand. Avoid long documents and details – quickly identify what has happened by simply comparing with the previous chart.

How to improve the quality system by using quality costs?

Communicate the results of the chart: publish it and explain it, with a short analysis about the status and proposed actions.
Quality costs have to be analyzed against an agreed quality standard: measure them, analyse them and identify reasons for non-improvement and improvement, then decide corrective actions to reduce non-quality costs further (more training, working group to analyze a specific problem, change the organisation,...).

Frequently Asked Questions:

- *How to start to measure non-quality costs?*
Start to count defects which are reported and evaluated. Then look at the way they change. Do not be surprised if non-quality costs are not reduced immediately.
- *How to convince the staff to register non-quality costs?*
Explain that it will enable everyone to quantify the benefits of the quality management system. Give them the assurance that it is not a way to measure personal efficiency. Offer rewards/awards for identifying non-quality costs and ways of reducing them.
- *How to communicate the results and progress?*
Use charts and publish them with a short analysis. Show that the results implies thanks or decisions for corrective actions.

10 Quality evaluation

This chapter is about quality control and quality assurance, both at the creation and maintenance of Geographic Information. This chapter is based on the quality standards being defined within ISO 19113, ISO 19114 and ISO 19115 by ISO/TC 211, and within CEN ENV 12656 and 12657 by CEN/TC 287.

The objectives of these European and International Standards are to provide principles for describing the quality for geographic data and concepts for managing that information.

Geographic datasets are increasingly being shared, interchanged and used for purposes other than those intended by their producers. The opportunity for data users to select any geographic dataset is expanding. The value of data is directly related to its quality and therefore information about the quality of available geographic datasets is vital to the selection process.

Data users confront situations requiring different levels of data quality. Extremely accurate data is required by some data users for certain needs and less accurate data are sufficient for other needs. Information about the quality of geographic data is becoming a decisive factor in its utilisation. Technological advances allow the collection and use of geographic datasets whose quality can exceed that which is needed and requested by data users.

The purpose of describing the quality of geographic data is to allow the selection of the geographic dataset best suited to application needs or requirements. Complete descriptions of the quality of a dataset will encourage the sharing, interchange and use of appropriate geographic datasets. A geographic dataset can be viewed as a commodity or product. Information on the quality of geographic data allows a data producer or vendor to validate how well a dataset meets the criteria set out in its product specification and assists a data user in determining a product's ability to satisfy the requirements for their particular application.

What kind of quality assurance should be used for the creation of Geographic Information (GI)?

⇒ Identify the main processes in its production:

For example the conversion from analogue to digital form.

When these processes are identified then a closer description may start and a timetable can be made. This ought to end up in both a timetable and a guide for the production of the Geographic Information. The guide could look like this:

- Product description: general description of the Geographic Information and it's characteristics.
- Contents: description of all features.
- Production specifications: description of how to construct the Geographic Information.
- List of quality records including results of tests and inspection, and proving that you did what was written with results being conform to the product specifications.

⇒ Specify quality parameters, such as the following ones and do measures:

See the quality standards for precise definitions.

Lineage: describing the origin of the source data. If the lineage is described, the user has a better chance of estimating the quality, limitations and potential use of the Geographic Information. For example each boundary in Danish cadastral maps contains database information about its origin.

Positional accuracy: can be both absolute/relative and horizontal/vertical. For example the altitude at which aerial photography was flown is decisive for the positional accuracy of the map data. There can be a decision that a proportion of features shall be accurate to 1 metre but 100% of each feature shall be accurate to 5 metre. The Geographic Information can be checked by comparing it either with terrestrial data or with other Geographic Information from the area (but there can also be errors in the control data).

Completeness: describes the presence and absence of features, their attributes and their relationships. Depending on the Geographic Information type, there are different tolerances for completeness. In cadastral information, 100% of the features shall be shown. However when technical and topographic information is made from aerial photographs, not all features are visible on the photo, and the supplier should state values for completeness.

Consistency: describes the percentage of polygons in the Geographic Information which is closed by snap, but it could also be the percentage of areas which cross other areas.

Semantic accuracy: Quality parameter that describes the accuracy of the semantic page of the Geographic Information dataset.

Temporal accuracy: Describes a period of time where the Geographic Information is valid until the next update.

User defined quality parameters

⇒ **Specify another parameters as metadata like:**

Currency: the user can find out when the data was created. This is used because old data is useless in an area where things change rapidly, e.g., in the city development areas.

Accessibility: who has the copyright for data and which conditions can be attached to the further use.

⇒ **Implement final control at the final step of the production line:**

Use visual control by comparing data with existing Geographic Information and look for obvious errors.

Use machinery control to be sure that the control is uniform, safer and you can detect small snap errors in polygons, which other wise is non visible and undetectable. Machinery control can also save a lot of manual work.

What kind of quality assurance should be used when updating Geographic Information?

When you have a good product it is obvious that you have to maintain it properly. Therefore you shall think at several points:

⇒ **Define how often to update:**

When you or your customers need it, or at fixed intervals? Should there be a different protocol for rural, stable urban and urban development areas? Cadastral maps and maritime charts are usually updated continuously.

The update protocol for Geographic Information often depends on their importance. For example:

- continuous update: road names, number of the house and road nodes.

- updated at least one time a year : buildings, railways, roads or paths,...

- update every 3 – 5 year: greenhouses, parking spaces, boundaries of use,...

- occasionally update : forests, lakes, coast line or trees,...

⇒ **Specify how to do it:**

This will be a choice between a totally new mapping or an update of selected events which happened since last update.

Updating will normally be the cheapest solution, but if the last update was a long time ago and the area has changed a lot, then a totally new mapping will be the best choice.

If there is a significant change in technology, or in the potential use of the Geographic Information, then it may be necessary to upgrade the data to a new specification.

⇒ **Identify who shall do it:**

The people who shall do the update must know the Geographic Information and its structure in precise detail. This can be achieved by using the same people who made the Geographic Information. It is important to document how the update shall be carried out, because a proper update means that the Geographic Information keeps its quality.

How to implement quality assurance when the production of GI has already started?

In general, when a NMA is studying the possibility of implementing a QMS, several production and updating processes have been in place for many years without having always taken into account QMS principles.

Evaluate the impact of the QMS on the existing production and update processes before its implementation.

The problem can then be split in two: firstly, design a new production flowline and update processes under the principles of QMS, taking advantage of the possibility of introducing some changes. Secondly, upgrade to some extent the dataset or maps already produced to meet the new quality standards, reengineering and repeating work only if it is unavoidable.

Frequently Asked Questions:

- *How can I measure the quality of the GI product?*

You need to identify the types of objects that are to be evaluated. Identify individual objects and groups of objects randomly, ensuring the groups can be used to assess consistency. Then either use software to compare the dataset to be evaluated with a reference dataset, or make a 'ground truth' check (which will cost a lot!).

- *How can I make sure that the GI product meets the requirement specification?*

Use one or both of:

- Quality inspection: measure the quality of the dataset and compare it to a reference dataset.
- Quality assurance: define the production process precisely and check that the producers have the necessary training and qualifications to do their job.

- *How can I compare/evaluate the quality of two different GI datasets?*

This depends on the quality parameters but most of the methods start with a step for matching objects from the dataset to be evaluated with objects from the reference dataset. After this step which may be automatic or visual, you have to count errors and to report the results based on the number of objects, or to the total of their length or surface.

- *What are the main quality parameters?*

These are positional accuracy, semantic accuracy, completeness, consistency, lineage and temporal accuracy. Use the available standards to know how to use these parameters.

11 Documentation

Document control is typically the most challenging aspect of ISO 9000 compliance. Starting with a simple, versatile structure provides the best opportunity to organize documentation and effectively orient the workforce. ISO 9000 contains rules and methods that an operating quality management system should consider. The standard defines "what" has to be done. It is part of the organisation's role, to prove "how" specific requirements are fulfilled.

Definitions:

Quality-related documents are distinguished between documents containing requirements for quality (related to activities or products) and quality records (documents stating results achieved or providing evidence of activities performed).

How to organise the documentation containing requirements for quality?

The typical classification for documents is a three-tiered system, often called the "quality documentation pyramid".

⇒ **Level 1: The top level of the quality documentation includes all documents describing the organisation**

These include quality policy (short, concise statements of the organisation's guiding principles), general responsibilities, general administrative rules, references to quality procedures. This level includes the quality manual showing what we do to conform to ISO 9000.

⇒ **Level 2: Procedures**

These provide organisational know-how; they briefly show inputs, outputs, activities and responsibilities for each business process. According to ISO 9000 a process is a system of activities which uses resources to transform inputs into outputs. Procedures document the specific realization of a process in an organisation. They are very useful for analysing the existing organisation, identifying overlaps and gaps and confused responsibilities.

The content of a procedure covers the following issues for example:

- objectives of the procedure, the field of application, the documents associated with the procedure, and the signatures of the authors and of an approver;
- the purpose of the procedure and aim of the process;
- abbreviations and definitions used in the procedure;
- a description of the process (e.g. flow-charts combined with a responsibility matrix);
- comments on the flow-chart;
- parameters and characteristic numbers to check the quality aims and to gather data for improvement;
- how the document is controlled (distributor, storage location of records);
- annexes.

⇒ **Level 3: instructions, the day-day instructions for a task**

The levels 1 and 2 form a network that connects the instructions which contain technical or professional know-how. It is important to find the balance between what is essential to record in order to do the job properly and what can be assumed from the performing operators knowledge through their training and education. The instruction has to ensure that every appropriate trained operator is able to follow it (not only the author of the instruction). It is possible to keep these instructions to a minimum, simply by stating what training/skills the operator should have in order to do the job. Others refer to equipment/software instruction manuals. They can also be replaced by software prompts and "help-routines".

Wherever it is possible use templates and checklists, preferably in electronic form, and incorporate the instructions in them.

These documents are an important influence on the effectiveness of a QMS, with a direct impact on the net added value. To guarantee the actuality and effectiveness of a QMS they must be updated when circumstances change. The advantage of structured documentation is that often only an instruction has to be updated without changing the higher-level procedure.

What are the rules for managing quality documentation ?

- ⇒ **Define the responsibilities**
for identification, approval and distribution of quality documents as specified in ISO 9000 standards.
- ⇒ **Defining the owner of the document**
According to a process oriented view the person most affected by an application is the owner of the process and therefore of the document.
- ⇒ **Defining the process**
It is important to analyse and document the existing processes and not to define new processes that seem to be better than the existing ones. Improvement will only work when the documentation describes existing processes.

What are the methodologies for writing quality documentation ?

A typical way to write and implement quality documentation is to (Dassonville, 1999):

- ⇒ **Choose a process-mapping approach**
The description of the processes can follow a *top-down approach* from the top management. In a top-down approach, the main processes are first identified, and then broken down in sub-processes and finally procedures describing the activities of the daily work.
Alternatively, a *bottom-up approach* can be used. This approach starts with a “floor-survey” among all categories of employees, asking them in interviews about their daily work. All activities taking 5-40 % in time are recorded and quantified. Activities taking more than 40 % should be sub-divided. The activities are then connected to workflows, and combined into procedures and processes.
The top-down approach must be based on the top management’s view of the business and its processes. This view is not always a true description, and for large organisations such as NMAs almost certainly not a complete view. The advantage of the bottom-up approach are:
 - all on-going work of any significance will be detected;
 - employees can be asked how much time they put into each activity and thereby distribute manpower costs to those;
 - they can also be asked to estimate time loss due to muddle and thereby locate candidate procedures for improvements;As the top management’s view of the company’s business must anyway characterise the final process map, a combined approach is ideal. The recorded activities from the floor-survey are combined and positioned in the overview process map coming from the management.

⇒ **Organize a project team**

This is a typical way to write and implement quality documentation. It has to be presupposed, that initiating the implementation of a QMS is a top down process (see chapter 6 Managing the implementation). Top management has to assign the project team for implementing a QMS. The project team usually consists of 5 - 7 people lead by the quality manager. The project team is responsible for analysing the main business processes of the organisation. It is also responsible for defining working groups and nominating the members of the working groups for each process. The working groups are chosen from people who are directly concerned with the process. The project team coordinates and supports the working groups by promoting consistent standards of documentation, such as the requirements of the ISO 9000 standard. The working group may have two or three meetings a month. Practically, one meeting may last about two hours and only one process should be analysed during that session.

⇒ **Organize the project into steps**

The analysis of main processes and the writing of the quality documentation should be systematic:

1. Identify the main processes to be analysed
2. Analyse each process
 - a) identify the lists of activities, responsible people, documents and quality records;
 - b) draw a diagram connecting all activities of the process with the main documents ;
 - c) review step a and b, and identify points to improve or to optimize within the working process.
3. Draw a diagram that shows the connections between all of the processes including selected documents; if necessary to repeat step 2 to include newly-identified processes.
4. Decide which processes have to be described with procedures and how many procedures one process may include. Most of the time, one process is equal to one procedure.
5. Write and review the chapters of the quality manual concerned with this process.
6. Write the procedures, by using all the work already done with the processes.
7. Prepare and set up a quality improvement plan for those items identified in the step 2c.

⇒ **Ask people who are involved to participate:**

It is not recommended, that procedures are written by the quality manager alone, even if the quality manager asks people to verify the documents. The best way to convince staff is to involve them and to incorporate their knowledge.

Frequently Asked Questions:

- *What kinds of document are to be recorded within the QMS?*
Define a classification for all documents and clearly identify documents describing procedures and processes. You may use the classical pyramid of quality. Be aware of the difference between quality records and quality documents. There are software systems to control documentation.
- *How to write a procedure?*
Define a standard structure. Analyse the practice of the staff who carry out the procedure and formalize the result with their help. Do not try to write everything : it will take too much time and it will be very difficult to maintain. 2 or 4 pages should be enough for a procedure. Validation and approval are essential parts of the documentation process.
- *How can processes be modeled, what kind of methods or tools exist? Which methods can be used to explain the relationships (network) between the processes?*
Create a working group and discuss together the content (activities, documents flows, responsibilities) of the process. Use diagrams to represent the result; it will be very useful to show the relationship between processes.
- *How to verify the efficiency of the documentation?*
Do internal quality audits and pay attention when documents are not used: there is something to improve there. Do not hesitate to simplify the documentation and to reduce its quantity.

12 Risk management

Risk management can be defined as a manipulation of the environment of a production process in such a way and at such a time that it is possible to get the right product at the right time, without noticeable interruption of the production process. Alternatively, "risk management is acting one step ahead of the appearance of a show stopper". Its process can be described as follows:

- ♣ *First, before starting a production flowline, the production manager tries to identify all risks that could occur. The manager then assigns two values to each risk: the possibility that it will occur, and its impact. (typically using a scale from 1 (low possibility/impact) to 5 for each. The combination of both possibility and effect gives an indication for the impact of each risk on the flow of the project if this risk occurs.*
- ♣ *The next step is to anticipate for each of these risks by planning solutions and workarounds if they should occur, or changing the existing operation slightly to reduce the risk. The risks with the highest impact must get the highest attention.*
- ♣ *During the realisation of the product, the production manager must be aware of the appearance of a primarily defined, but until that time not really handled, risk, and then act as planned. If an unforeseen risk occurs then its effect on the product has to be estimated as above and the reaction planned and carried out.*

Risk management for implementing a QMS consists of dealing with big and small objections, coming from people all over the organisation, and can, in general, not be quantified in the same way as the risks in a production process. These are termed "objections" instead of "risks" in the following sections.

Objections can be divided into two classes:

1. Objections related to the production of the "hard" products (procedures, handbooks etc...). Foreseeable objections are for instance lack of education, lack of time etc... Anticipating steps can be: good education, good contacts with other production or project leaders, good synchronising with other projects.
2. Objections related to the conceptual part in the process, for the implementation of a QMS affects all the people inside the organisation. In almost all cases the right anticipating step is to set up good communication and good document management. These will ensure a good, clear and understandable information flow about the QMS and its status inside the organisation: what it is, what are the intentions, what will it mean for the whole organisation and to each individual, the status of the implementation, etc...

Possible objections against the implementation of a QMS and possible (re)actions:

In most of the following examples of objections to the implementation of a QMS, only a short indication of either "normal production objection" or "conceptual objection" is given, based on the paragraphs above. In case it is more or less evident in what direction the minimisation of this risk points (see paragraph above). Some explanation is added for the less obvious cases.

Possible objections coming from the top management:

⇔ **Lack of support**

If it affects the production part: synchronise activities with other processes.

If it affects the concept: give as much information as possible.

Also: implementation of a QMS takes a lot of time and effort, whereas the top management wants benefits on a short period of time.

⇒ **Short-term increase of production cost during training and implementation of the QMS**

This objection affects the concept and can be minimised by giving as much information as possible about a QMS in general. Also it is difficult to get a good sight of the balance between the extra costs of implementing a QMS and the costs caused by a lack of quality, because good figures about the latter are usually unavailable.

Possible objections coming from the staff:

⇒ **Less satisfaction by the staff because of new methodology – e.g. resistance to change and perceived risk of ‘exposure’**

The new methodology has to be present as a tool to help people to do their work better. Giving them the opportunity of defining and describing quality controls can be seen as a way to integrate people in the organisation. If quality controls are fully implemented, workers have a way to demonstrate in a more objective way that they have done their task perfectly.

This objection affects the concept too. The solution to this risk is also give as much information as possible.

⇒ **A QMS is just another set of rules and papers without actual results, e.g. the produced documents reflect what management think is happening, not what is happening**

This objection can be seen as a concept risk, with the solution as above.

Also let the writing be done by the same people who do the work; describe in the first place only the complex parts of the procedures.

⇒ **No improvement of the quality level in the final product**

The answer to this objection is that just the existence of documentation enriches the product as the product can be compared with what is specified in the documentation.

⇒ **Additional bureaucratic effort with no gain**

Another conceptual objection with the same solution.

Also, although the product itself has not improved, the fact that the production process is well described implies that the production is better.

⇒ **More difficult subcontracting**

An organisation with an implemented QMS must be sure that a subcontractor meets the same quality levels as in-house production to avoid decrease of quality in the final product.

Risks coming from the project team:

⇒ **Updating different procedures and quality manuals takes a lot of time**

This is also a conceptual objection which can be minimised by sufficient information and good education.

Frequently Asked Questions:

- *What is Risk Management?*
Dealing with the environment of a production process so that it is possible to get the right product at the right time.
- *What is Risk Management during the implementation of a QMS?*
Dealing with big and small objections from staff that cannot be quantified as risks in a production process.
- *What kind of objections can I expect when I have to implement a QMS?*
Objections from the top management: lack of support, increase of production cost.
Objections from the staff: dissatisfaction because of new methodologies, another set of rules and papers without actual results, no improvement of the quality of the final product, additional bureaucratic effort, more difficult subcontracting, less satisfaction by the staff.
- *How to react on each of these objection?*
The solutions are different for each objection, but use communication, education and training, all and only the necessary documentation, cost control and precisely-defined responsibilities.

CONCLUSION AND FUTURE PLANS

So now it is done. It is finished and yet as with all quality management documentation if it is successful then it has only just started.

In the tradition of QMS a document has been created by the members of the CERCO Working Group on Quality to record the experiences of people who have been involved in creating a QMS – and their on-going development. This one-year work provides balanced views of the positive and negative aspects associated with such systems. Writing this document was a good opportunity for all members to exchange their practical experiences, and we each hope to get some benefits within our own NMA.

This handbook may be used as a guideline that provides a general framework for implementing a QMS. This framework gathers common points of view of all the members of the CERCO Working Group on Quality, but it is interesting to think of the different ways that all the NMAs have chosen to reach the goal of quality management.

Our intention is to improve the document progressively over the coming years.

There are a number of areas we plan to enhance the document. The inclusion of templates will provide some practical examples of how to use the system and some case studies of particular aspects are just two areas where improvements will occur over the next year or so.

Changes to the ISO 9000 standard in the next year or so will necessitate changes to the document. As before, the document will aim to set out the experiences of people involved with making changes to a QMS.

The group that has created this document will change in membership over the coming years. As this occurs, new people will no doubt bring new experiences – and their thoughts will be included into the document. And so the document will continue to allow people from different backgrounds to share their experiences in this area.

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CERCO : <http://www.cerco.org>
CEN : <http://www.cenorm.ce>
ISO : <http://www.iso.ch>

MAIN AUTHORS

Laure Dassonville, IGN - France, Laure.Dassonville@ign.fr

Laure Dassonville is working at the French NMA IGN (National Geographic Institute). Since 1997, she is the head of IGN quality department with the responsibility of coordinating the IGN quality approach. She worked primarily in the production department for the French IGN road database as the Project Manager. From 1998, she is the chairwoman of the CERCO Working Group on Quality and of the sub working group on quality management. She is a senior survey Engineer from the French ENSG school since 1987.

Jorgen Giversen, KMS - Denmark, jgg@kms.dk

Jorgen Giversen is working at the Danish NMA KMS (National Survey and Cadastre - Denmark). Since 1998, he is head of the Systemsektion at KMS with the charge of development of the Cadastral map system at KMS. He has since 1993 worked as a GIS-consultant in a small Danish GIS company. From 1998, he is member of the CERCO Working Group on Quality, and participates to its Coordination Committee. He is a Chartered Surveyer from AAU (Aalborg University) from 1993.

Tim Hancock, MEGRIN, Tim.Hancock@megrin.org

Tim Hancock is working with MEGRIN on secondment from Ordnance Survey Great Britain. In MEGRIN, he is responsible for all work on metadata.

Karl Haussteiner, BEV - Austria, Karl.Haussteiner@bev.gv.at

Karl Haussteiner works at Austria's Federal Office of Metrology and Surveying. In 1998, he became the quality manager of the surveying division, which represents the Austrian NMA. Currently he is involved in the project "Development and implementation of a Quality Management System at the BEV". Between 1993 and 1998 he worked for the BEV's department of photogrammetry and remote sensing. He graduated from the Technical University of Vienna in 1992 and holds a master's degree in surveying.

Major Turgut Kurttekin, GCM - Turkey, tkurttekin@hgk.mil and Lt.Col.Kadri Pamukoglu

Major Turgut Kurttekin is a Msc.Survey Engineer and working in Turkish General Command of Mapping since 1984. He worked in different departments mainly Geodesy, Plans and Principles and Cartography. He was also main contact officer of GCM within CERCO. Since July 2000 he is working in HQ of GCM. Lt.Col.Kadri Pamukoglu is a survey engineer and working in Turkish General Command of Mapping (GCM) since 1979. He worked in different departments of GCM, mainly Geodesy, Plans and Principles. He is chief of System Development and Application Branch in Information Systems and Support Department. He is also Head of Quality Inspection Board in GCM.

Thierry Mercier, IGN - France, Thierry.Mercier@ign.fr

Thierry Mercier is survey ingenior at the French NMA IGN (Institut Geographique National) since 1987. From end of 1996 to beginning of 1999, he was leading a project in charge to conform to the ISO 9000 the BDCarto database production line.

Ema Pogorelcnik, SMRS - Slovenia, ema.pogorelcnik@gov.si

Ema Pogorelcnik is working at the Surveying and Mapping Authority the Republic of Slovenia as a Director Adviser. She specializes in the Building Cadastre and the Register of Geographic Names. She is also a member of the Government Commission for the Standardization of the Geographic Names. She also works as procurement officer in national and World Bank procurement system.

Antonio Rodríguez, IGN - Spain, arodriguez@mfom.es

Antonio Rodríguez is working at the Spanish NMA, IGN (National Geographic Institute) for 14 years. Since 1994 he is the head of GIS Department, in charge of the production of the vectorial geographic databases of IGN Spain. Since 1994 he is also in charge of the Secretariat of AEN/CTN148 (Standardization Technical Committee 148 of AENOR) "Digital Geographic Information" and he has been involved in standardization activities at european level (through CEN/TC287) and international level (through ISO/TC211).

Toon Van Roosmale, Topografische Dienst - The Netherlands, troosmalen@tdn.nl

Toon van Roosmalen is working at TDN (Topografische Dienst Nederland), the Dutch Topographic Institute. Momentary he is the head of the ICT department and responsible for all hardware and software throughout the Service. Before that he worked at the Topographic Department, where he was, amongst others, responsible for quality aspects. He is a geodesist since 1976.

David Sharman, Ordnance Survey - Great Britain, dsharman@ordnancesurvey.gov.uk

Dave Sharman is the Ordnance Survey's Project Manager for an EU Technical Assistance Project in the Slovak Republic. Between 1996 and 1999 he was Project Manager, Data Management in Ordnance Survey, responsible for the specification, assurance, assessment and correction of Ordnance Survey's mapping data. He has also been a member of various British and European working groups for Geographic Information standards since 1993, and has participated in the development and assessment of Ordnance Survey's quality management system.

Hakon Wikström, NLS- Sweden, hakon.wikstrom@lm.se

Hakon Wikström is a Senior Consultant and a Project Manager at the National Land Survey of Sweden (Lantmäteriverket/Metria). He is currently working in a project for a Quality and Environmental Management System, acting as a Quality Manager. He is a chartered surveyor from the Royal Institute for Technology of Stockholm and has since 1972 been working with systems development and maintenance, specifications and standardisation for both cadastral and Geographic Information.

MEMBERS OF THE CERCO SUB WORKING GROUP

"QUALITY MANAGEMENT AND ISO 9000"

Dolors Barrot, ICC- Catalunya, dolors@icc.es

Dolors Barrot is working at the ICC (Institut Cartogràfic de Catalunya), MA of the local Government of Catalonia, Spain. Since 1998, she is responsible for quality and methods department with the charge of coordinating the quality evaluation procedures. She is a Mathematicien from the University of Barcelona since 1982.

Laure Dassonville, IGN - France, Laure.Dassonville@ign.fr

See main authors

Jørgen Giversen, KMS - Denmark, jgg@kms.dk

See main authors

Tim Hancock, MEGRIN, CERCO, tim.Hancock@megrin.org

See main authors

Karl Haussteiner, BEV - Austria, nfranz@bev.gv.at

See main authors

Tom Otto Husvik, SK - Norway, tom-otto.husvik@statkart.no

Tom Otto Husvik is working at the Norwegian Mapping Authority since 1980. He was a project manager for the project "Building and implementing a quality system for the Land Mapping Division" in 1995 - 1997. From 1998 he is a Quality Manager in the Land Mapping Division.

Turgut Kurttekin, GCM - Turkey, tkurttekin@hgk.mil.tr

See main authors

Thierry Mercier, IGN - France, Thierry.Mercier@ign.fr

See main authors

Ema Pogorelnik, SMRS - Slovenia, ema.pogorelnik@gov.si

See main authors

Antonio Rodriguez, IGN - Spain, arodriguez@mfm.es

See main authors

Joaquín Rodríguez, CNIG - Spain, joaquin@cnig.ign.es

Toon Van Roosmalen - Topografische Dienst - The Netherlands, troosmalen@tdn.nl

See main authors

David Sharman, Ordnance Survey - Great Britain, dsharman@ord.s.gov.uk

See main authors

Václav Slaboch, VÚGTK, Czech Republic, vadav.slaboch@vugtk.cz

Václav Slaboch is working since 1998 as the Director of the Research Institute of Geodesy, Topography and Cartography (VÚGTK), which belongs to the Czech office of Geodesy, Topography and Cadastre (CUZK). He is responsible for the research in the of Geodesy and Cartography including the quality assurance.

Hakon Wilström, NLS- Sweden, hakon.wilstrom@lm.se

See main authors

Vilius Zilevicius, AGI - Lithuania, agi@kaunas.omnitel.net

Vilius Zilevicius is working at the Institute of Aerial Geodesy (AGI) which is functioning as National mapping centre of Lithuania. He joined AGI in 1996 from Kaunas University of technology where he received doctor degree in Informatics. He works in the fields of digital mapping and Geographic Information systems.

APPENDIX A : EXAMPLE OF A QUESTIONNAIRE FOR CUSTOMER'S SATISFACTION

PROVIDED BY METRIA - LANTMATERIET - SWEDEN

File no.:

Customer:

.....

Business:

.....

With your view on our delivery we may improve

We are aiming at the satisfaction of our customers. Our primary quality measure is our customer's satisfaction. Therefore, we would appreciate knowing how you are appraising us in this delivery.

Information

supplier:

.....
Date Name Phone.

Time of delivery met?.....

Yes

No

Overall ranking of delivery? ...

☐☐☐☐☐

Very

Good

Approved Bad Very

good

bad

Please, fill in and return this form in the attached envelope.

We would appreciate if you are using the option to further detail your overall ranking.

Please tick the aspects of delivery which you find better or worse than expected.



Conformity to order.....

Co-operation and communication

Availability

Skill and Competence

Solving problems connected to delivery.....

Documentation / Report

Others

☐
☐
☐
☐
☐
☐
☐

☐
☐
☐
☐
☐
☐
☐

Comments:

.....

APPENDIX B : ISO 9001 [1994] AND GEOGRAPHIC INFORMATION

Chapter 1 : Top management responsibilities

Include a page with the commitment of the top manager to implement the quality system and to verify its efficiency.

Explain the quality policy and how it is or will be implemented, including: definition of quality objectives, quality review, quality indicators (including quality costs), tools for communicating quality results.

Describe the organisation, and especially the responsibilities for quality managers and all the staff responsible for quality inspection and conformance decisions.

Chapter 2 : Quality management System

Describe the structure of quality documentation: quality manual, procedures, instructions and quality plans if required for specific products. Do not forget to mention product specifications (content and quality objectives).

Chapter 3 : Contract review

Describe the way you will guarantee the contractual requirements: Do you agree with the contractual requirements? Are resources available? Is the production process performed? Did you solve all the possible problems with the customer? What will happen if a change occurs in the contract?

Chapter 4 : Design control

Describe the way you plan and organize your design (the “design” concerns the design and the development of the production processes). Specify the input and the output data for the designing process. Define the way you will verify and validate the “design”.

Chapter 5 : Document and data control

Publish a list of all applicable documents and define rules for identifying, writing, reviewing, approving, distributing and modifying documents. Avoid writing too many documents (it will take time to write and maintain them). Ensure suitably qualified and competent people are involved (see chapter 18).

Chapter 6 : Purchasing

Create a list of goods and services required together with potential suppliers. Find indicators to evaluate the suppliers (on time delivery, respect of the specifications, quality level) and be sure that goods and services are well described.

Chapter 7 : Control of products supplied by the customer

It is important to be careful with products supplied by customers. Information that you will introduce within your maps or databases must keep to the appropriate precision.

Chapter 8 : Product identification and traceability

Define the inputs to and outputs from a process. This will allow you to identify the original cause if a problem occurs. Use of metadata (e.g., lineage) to store some of this information may be helpful.

Register the release of the specifications and of the processes you use to produce your geographic product. Tracking what you do will simplify your work in identifying a problem and any consequences it may have had on other maps or data sets.

Chapter 9 : Process control

Describe the way you plan the production in order to prove that you will be able to produce on time. Explain the way you qualify processes and equipment to ensure that the production will be homogeneous and continuous. Define foresee maintenance procedures in order to be ready to act in case of break of the equipment and software.

Chapter 10 : Inspection and testing

Identify steps for inspection or verification. Describe exhaustive or statistical inspection. Be aware that each element of geographic information is unique and that you will have to find efficient inspection to prove that the data will meet the customer's satisfaction. Register the results for inspection and who did them. Check whether people who are in charge of this task have the correct qualifications. Be sure that the sources you use are appropriate (i.e., more precise).

Chapter 11 : Control of inspection, measuring and test equipment

Describe the processes for calibration and maintenance of the equipment dedicated to inspection and testing. For instance, check that digitizing tables are calibrated correctly. Be sure that the software you are using for inspection is performing as expected.

Chapter 12 : Inspection and test status

Find a way to quickly identify conforming and non-conforming products. You should keep a register of the inspection results.

Chapter 13 : Control of non-conforming product

Identify people who will decide when products conform to the specification in respect of content and quality. Use results of quality inspection and other proof that the production processes have performed correctly. Explain what happens when the product is non-conform.

Chapter 14 : Corrective and preventive actions

Describe the sources you use to decide when to take corrective actions (i.e., when a fault occurs) and preventive actions (i.e., when you think that a fault may occur). The sources will include quality audit and quality inspection reports and customers' claims.

Chapter 15 : Handling, storage, packaging, preservation and delivery

Describe the precautions you take in order to secure these operations. For instance, periodically back up numeric data.

Chapter 16 : Control of quality records

Describe how you identify, collect, and store quality records: test and inspection results, check-lists and any documents giving quality assurance.

Chapter 17 : Internal quality audits

Describe the way you perform internal quality audits – including the use of qualified auditors, audits plannings, procedures and reports to register the conclusions.

Chapter 18 : Training

Describe the competencies required by people involved with geographic information and explain how you will ensure that people are correctly qualified.

Chapter 19 : Servicing

Give information for helpline facilities, training or data installation.

Chapter 20 : Statistical techniques

Prove that you correctly using statistics, especially for the examination of data sets.

APPENDIX C : EXAMPLE OF COURSES ON QMS

TITLE AND PERIOD OF TRAINING	CONTENTS/PROGRAM	PARTICIPANTS
1) Quality Assurance System (4 days)	-Terminology and concepts related with quality -Quality costs -Introduction of ISO 9000 series standards -Organisation structure of QMS -Advantages of QMS -Management of papers and procedures -Sample studies	-Top level managers -People to be qualified on quality assurance
2) Quality System Documentation (3 days)	-Document structure of QMS -Quality manual (handbook) -Procedures -Support documents (Specifications, forms etc.) -Document control -Sample studies	-People who prepares the documents of QMS -People trained in topic (1) or who will manage the related works
3) Internal Quality Audits (3 days)	- Introduction of ISO 10011standards -Types of audits -Advantages of audits -Planning and management of audits -Lists of questions -Report writing of audits -Responsibilities of auditors -Sample studies	-Managers and workers responsible for Internal Quality Audits -People qualified on the topics (1) and (2)
4) Total Quality Management (2 days)	-Concepts of TQM -Continuous improvement -Organisation culture -Dependency -Participation of all people -Planning, training and measuring	-Top level managers -All managers
5) Quality Circles (4 days)	-Introduction -Problem prevention techniques -Data acquisition techniques -Brainstorming techniques -Group works -Reason/Result analysis -Presentation to Administration	-Medium level managers -Workers
6) Problem solving techniques (2 days)	-Concepts of quality and customer -Continuous improvement -Logic of statistics -Flow diagrams -Reason / Result diagrams -Making decisions -Planning	-All level workers/managers
7) Suppliers and subcontractors Relations	Evaluation of supplier quality system including:	Managers and staff responsible for Organisation purchasing

(2 days)	-Process documents -Purchasing document control -First sample (prototype) and approval -Entrance control -Non-conforming supplies -Purchasing and approval procedures	
8) Statistical process control (3 days)	-Basic knowledge on Quality system and Quality control -Requirement for statistical techniques -Basic statistical concepts -Process control by statistical methods -Verifying and measuring of processes -Data acquisition methods -Determination of critical processes -Analysis of processes -Improvement methods of processes -Sample studies	-Section workers who implement and evaluate the statistical activities
9) Process management and improvement (2 days)	-Process management and functional management -Definition of processes -Determination of process owners -Determination of critical processes -Analysis of processes -Improvement methods for processes -Sample studies	-All level managers -Staff involved with process improvement
10) Benchmarking	1) Benchmarking types 2) Data acquisition and analysis 3) Implementation 4) Review and improvement	-Top level managers -Team leaders
11) Calibration (1 day)	-Implementation of calibration in ISO 9000 -General information -Documentation of calibration -Determining calibration periods -Introduction of calibration environment	-People responsible for calibration