

# GUIDE TO THE INTERPRETATION AND APPLICATION OF THE ISO 9001:2000 STANDARD FOR THE CONSULTING ENGINEERING INDUSTRY

## Electronic Edition

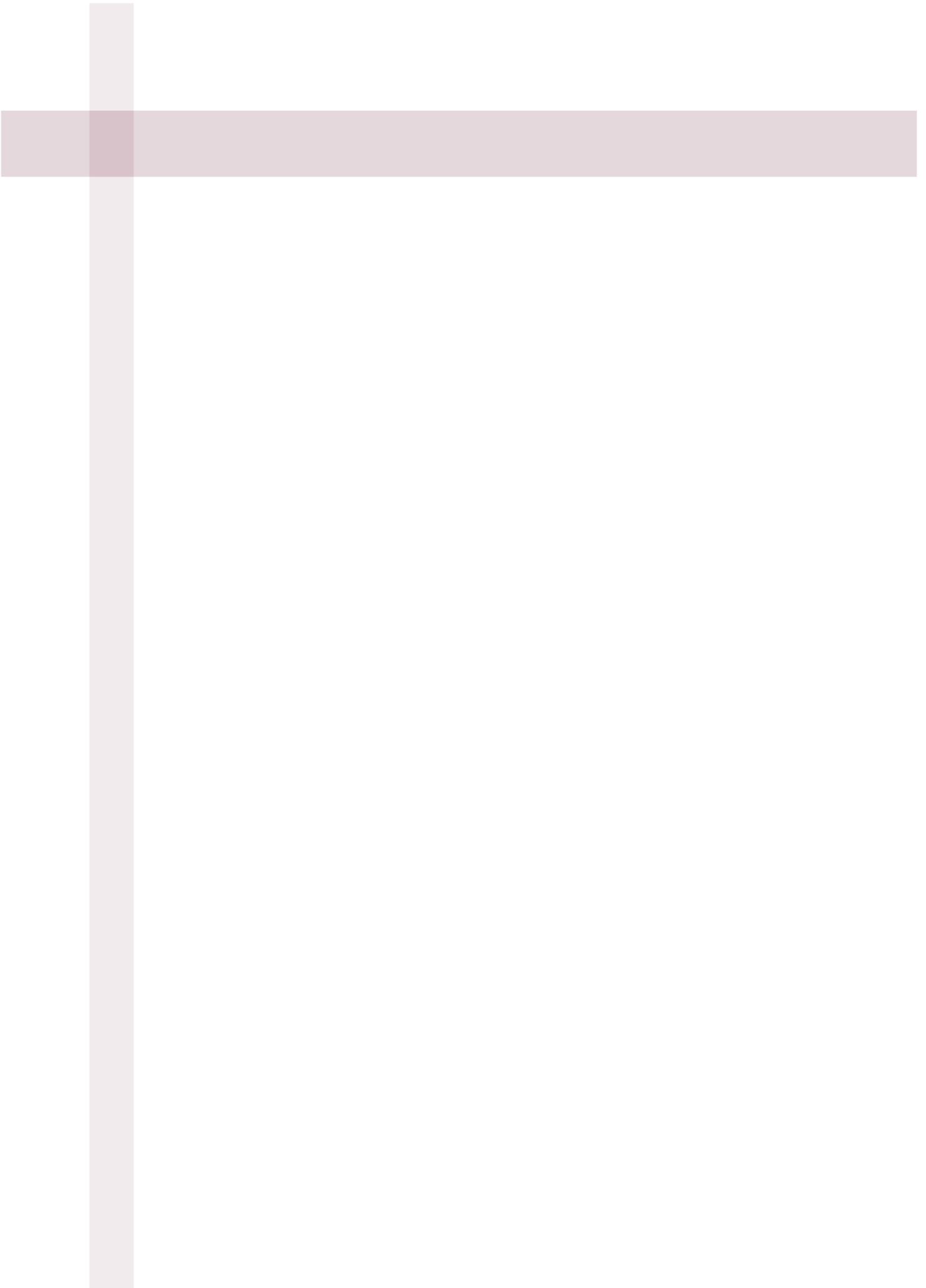


European Federation of Engineering  
Consultancy Associations



Fédération Internationale des Ingénieurs-Conseils  
International Federation of Consulting Engineers  
Internationale Vereinigung Beratender Ingenieure  
Federación Internacional de Ingenieros Consultores





## **FIDIC is the International Federation of Consulting Engineers**

FIDIC was founded in 1913 by three national associations of independent consulting engineers within Europe. The objectives of forming the federation were to promote in common the professional interests of the member associations and to disseminate information of interest to members of its component national associations.

FIDIC membership at present numbers over 60 countries from all parts of the globe. The federation represents most of the private practice consulting engineers in the world.

FIDIC arranges seminars, conferences and other events in the furtherance of its goals: maintenance of high ethical and professional standards; exchange of views and information; discussion of problems of mutual concern among member associations and representatives of the international financial institutions; and development of engineering consulting in developing countries.

FIDIC publications include proceedings of various conferences and seminars, information for consulting engineers, project owners and international development agencies, contract documents and client/consultant agreements. They are available from the Secretariat in Switzerland, and at [www.FIDIC.org/bookshop](http://www.FIDIC.org/bookshop)

## **EFCA is European Federation of Engineering Consultancy Associations**

EFCA was founded in 1992. It comprises 25 national associations from 24 European countries, representing over 8,500 firms, employing some 200,000 staff.

EFCA is committed to represent and promote the professional interests of engineering consultants across Europe. To that end EFCA acts on the national associations' behalf as a dialogue partner with the European Commission and other European institutions, and offers assistance so that European Union legislation affecting the work of engineering consultancy providers is fair to both the industry and society as a whole.

EFCA uses its unique position to stimulate contacts between managers of individual firms by acting as a platform for the exchange of ideas and experience, and by arranging for a place to find business partners.

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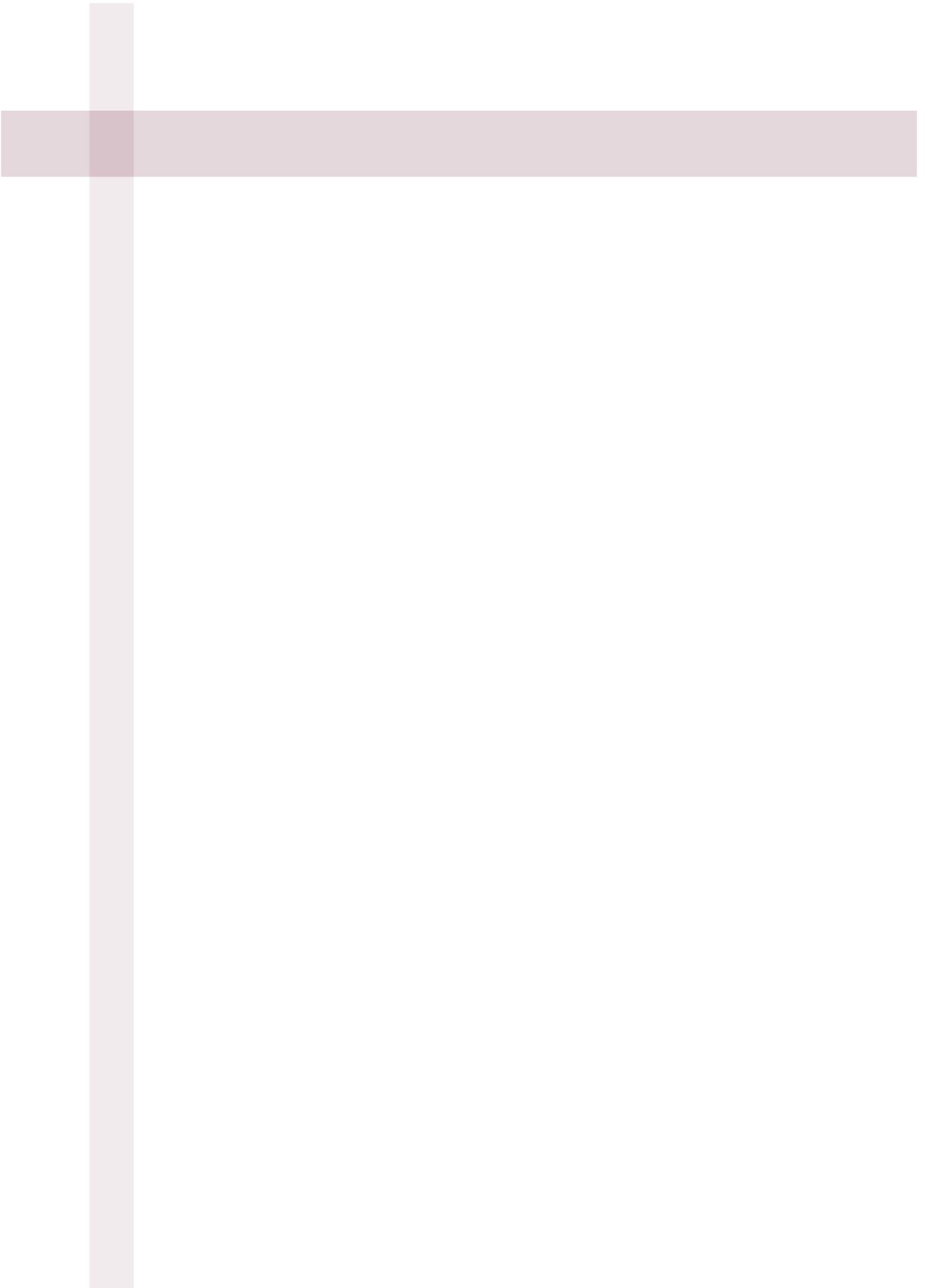
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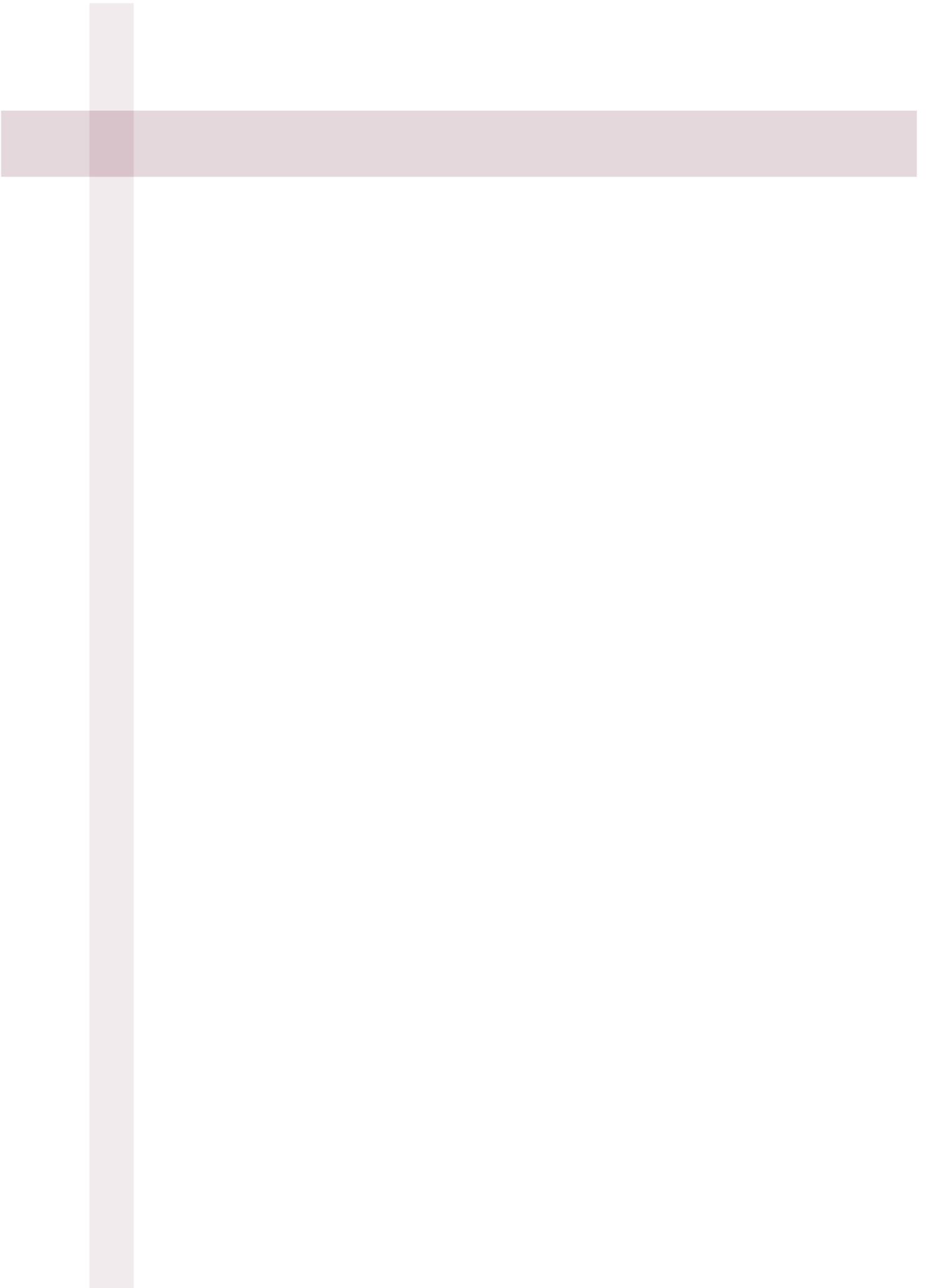
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# Preface

In 1997 FIDIC and EFCA issued the *Guide to the Interpretation and Application of the ISO 9001:1994 Standard for the Engineering Consulting Industry*. This present document is an updated version of that guide to reflect the revised ISO 9001:2000 Standard.

The primary purpose of this guide has been to produce a layman's guide to apply a Quality Management System based on the ISO 9001:2000 Standard. We endeavoured to keep the language simple and relevant to the engineering consulting industry. We sincerely hope that the guide will facilitate the understanding of the ISO 9001:2000 Standard by members of our industry.

One should bear in mind that substantial changes have been made from the 1994 edition of the Standard to the 2000 edition. These changes influence the way quality management is to be perceived in consulting firms. The new Standard focuses on management's commitment, processes and process control, provision of resources, continual improvement and customer orientation, with less emphasis on documentation.

The guide has been reviewed by many individuals and organizations. Input has been received from various individuals, professional consultants, member associations and individual firms. FIDIC and EFCA are indebted for all suggestions and advice, but take sole responsibility for the contents of the guide.

The guide has been prepared by FIDIC's and EFCA's Task Force on Quality Management both under the chairmanship of Tonny Jensen, Denmark. Significant contributions were made by Diane Bagueley, New Zealand, and Alex Ezrakhovich, Australia.

FIDIC and EFCA would be pleased to receive feedback from the users of the guide on its usefulness, and on areas for improvement. Comments and suggestions for improvements should be forwarded to either of the FIDIC or EFCA secretariats.

# 1 Introduction

## 1.1 Purpose of the Guide

This guide seeks to assist firms in the consulting engineering industry in choosing and determining how best to apply the ISO 9001:2000 standard to their operations.

The guide should be read in conjunction with the ISO 9001:2000, ISO 9004:2000 and ISO 9000:2000 standards.

The guide consists of five main sections:

- 1 Introduction
- 2 ISO 9001 process approach to Quality Management Systems
- 3 Application of ISO 9001:2000 to consulting engineering services
- 4 Interpretation of ISO 9001:2000 requirements for the consulting engineering industry
- 5 Appendices

For more information on the ISO 9000 family of standards beyond the interpretation and guidance given in this document, please refer to Appendix B.

The guide covers all services provided by a consulting engineering firm, and is not limited to design services only. It is a companion to:

- The document titled: *Guide to Quality Management in the Consulting Engineering Industry* published by FIDIC in 2001. In that document, the concept of Quality Management is described independent of external requirements, and the document outlines a procedure on how a Quality Management System can be developed, implemented and continually improved.
- The PowerPoint presentation titled: *Training Kit on Quality Management in Consulting Engineering* published by FIDIC in 2001. This presentation includes an introduction to Quality Management within the consulting engineering industry.

This guide focuses on the application and interpretation of the ISO 9001:2000 standard in the consulting engineering industry. However, even without compliance with ISO 9001:2000, the firm can expect significant benefits from the application of the FIDIC document *Guide to Quality Management in the Consulting Engineering Industry*.

The ISO 9001:2000 standard does not require that a Quality Management System must be certified/registered. Electing to seek certification/registration of a Quality Management System to ISO 9001:2000 is a business decision. Many clients and countries are committed to ISO certification/registration. This is an attractive course for some consulting engineering firms, since ISO 9001:2000 is an international standard consistently applied and verifiable by accredited third-party certification/registration bodies.

Certification/registration brings a host of benefits, not the least of which is customer and stakeholder confidence, and the recognition the firm deserves. Before the actual certification/registration, it is essential to have the system in place and running for a few months.

The consulting engineering firm should ensure that striving for compliance with ISO 9001:2000 does not override either good business practice or adherence to basic quality management principles.

# 1 Introduction

## 1.2 What is the ISO 9000:2000 Family of Standards?

The ISO 9000:2000 family of standards consists of three primary documents:

- ISO 9000:2000 Quality management systems - Fundamentals and vocabulary
- ISO 9001:2000 Quality management systems - Requirements
- ISO 9004:2000 Quality management systems - Guidance for performance improvements

The ISO 9001 and ISO 9004 standards are developed as a “consistent pair” of standards. Their structure and sequence are closely similar, in order to facilitate an easy and useful transition between them. The ISO 9001 standard

addresses the Quality Management System requirements for an organization to demonstrate its capability to meet customer needs. ISO 9004 leads towards the development of a comprehensive Quality Management System, designed to address the needs of all interested parties (stakeholders), i.e., the owner/principal, the employees, the subconsultants and other collaborators in a project, as well as society at large. ISO 9001 focuses on the effectiveness of the Quality Management System (external benefit to the customer), whereas ISO 9004 also addresses the efficiency of the Quality Management System (internal benefit to the organization). It is therefore recommended that one uses the guidance for the performance improvement provided in ISO 9004, as well as the interpretative guidance provided in this document.

## 1.3 Differences between ISO 9001:1994 and ISO 9001:2000 - main changes

There is a considerable reduction in the number of standards and guidelines in the ISO 9000 family from the 1994 edition to the 2000 edition, including withdrawal of the previous requirements standards ISO 9002 and ISO 9003.

A number of fundamental changes have been incorporated into the 2000 edition compared to the 1994 edition. In summary, the 2000 edition document approaches Quality Management Systems as a series of processes consistent with the Plan-Do-Check-Act concept.

The main changes from the 1994 edition are:

- Provision for organizations to exclude application of some ISO 9001 requirements
- A new process-oriented structure and a more logical sequence of the clauses. The structure of the standard is now more balanced and aligned with business needs and working practices
- Introduction of a requirement to identify and manage the processes needed for quality management, including their sequence and interaction
- Reduction in the number of mandatory procedures and less emphasis on documentation
- Increased emphasis on the role of top management in the development, implementation and continual improvement of Quality Management Systems

- Increased focus on the determination of product requirements, including statutory and regulatory requirements
- Increased attention to the provision of resources: human resources, infrastructure and the work environment
- Requirements for internal communication as well as communication with the customer
- More emphasis on personnel competence and awareness
- Clarification of the organization’s responsibility for outsourced processes
- Greater orientation towards the continual improvement process. Continual improvement is now a mandatory requirement of the standard
- Greater customer orientation. Focus on identifying customer needs and expectations, and providing customer service. The firm is now required to measure and monitor performance, as perceived by the customer, by establishing and implementing methodologies for assessing customer satisfaction
- Increased compatibility with the environmental management system standard ISO 14001.

# 1 Introduction

## 1.4 Transition from ISO 9001:1994 to ISO 9001:2000

It should be straightforward to adapt a Quality Management System based on ISO 9001:1994 to the requirements of ISO 9001:2000 without extensive rewriting of the Quality Management System documentation. Adaptation should be readily achieved if the existing Quality Management System has been based on the development of project quality plans to govern the conduct of the firm's work, since this fits the process model.

The "head document" – Quality Manual or equivalent – will need to be revised to ensure that the additional requirements of the standard are addressed. Conducting this revision can be used as an opportunity to review the existing system against each clause of the new standard. Where existing procedures and work instructions have been successfully implemented, they can usually be kept largely unchanged.

It also will be advisable to describe the Quality Management System in a way that fits the process model, keeping in mind that the structure and style of documentation is at the discretion of the firm.

It is important to check that all the firm's processes involved in providing those services that are within the scope of its Quality Management System have been identified.

Some additions and/or revisions to procedures are likely to be required to meet new requirements, in particular:

- Greater attention to defining customer requirements, including those not specified by the customer or necessary to meet statutory and regulatory requirements
- Monitoring the information about customer perceptions of whether or not the firm has met customer requirements
- Analysis and the use of data on customer satisfaction, services, processes and the Quality Management System performance.

## 2 ISO 9001 process approach to Quality Management Systems

This section draws from the ISO document *Guidance on the Process Approach to Quality Management Systems*.

### 2.1 The Process Approach

One of the eight quality management principles on which the ISO 9000:2000 family of standards is based relates to the "Process Approach" as follows:

**Process Approach:** a desired result is achieved more efficiently when activities and related resources are managed as a process.

ISO 9000:2000 Clause 3.4.1 defines a "process" as:

A set of interrelated or interacting activities which transforms inputs into outputs

NOTE 1: Inputs to a process are generally outputs of other processes.

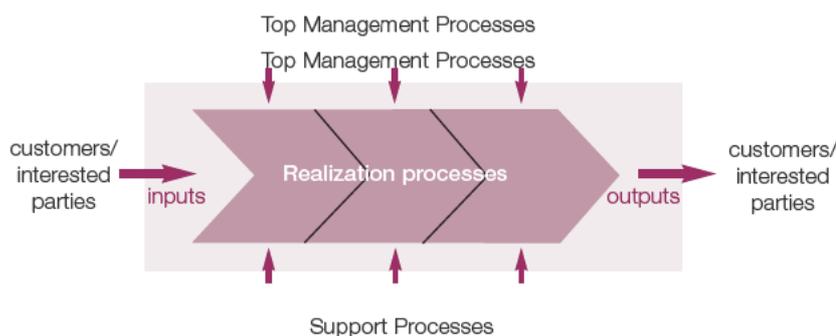
NOTE 2: Processes in an *organization* are generally planned and carried out under controlled conditions to add value.

Inputs and outputs may be tangible or intangible. Examples of inputs and outputs may include equipment, materials, components, energy, information, survey results, the result of a calculation, a decision, and financial resources, among others. To perform activities within the process,

appropriate resources have to be allocated. A measurement system can be used to gather information and data to analyse process performance as well as input and output characteristics. Consulting engineering firms are generally aware of design as a process having inputs, design activities and outputs (design deliverables). Applying the same concept to other processes should therefore be straightforward.

ISO 9001:2000 stresses the importance for an organization to identify, implement, manage and continually improve the effectiveness of the processes that are necessary for the Quality Management System, and to manage the interactions of these processes in order to achieve the organization's objectives. This includes top management, product realization and support processes, as well as the monitoring and measurement processes that need to be built into every process of the organization.

A schematic representation of the typical processes within the Quality Management System of a consulting engineering firm is shown in the figure.



#### Organizational processes

Top management processes include, for example, management system planning, internal audits and management review

Realization processes include, for example, forming agreements with clients, conducting design work and delivering services to clients

Support processes include, for example, managing competence and training, and controlling files and records

## 2 ISO 9001 process approach to Quality Management Systems

### 2.2 The P-D-C-A Cycle and the process approach

PDCA (“Plan-Do-Check-Act”) is a dynamic cycle (see figure) that can be deployed within the organization’s processes, and to the system of processes

as a whole. It is intimately associated with the planning, implementation, control and continual improvement of all processes at all levels within the organization.

The Note in Clause 0.2 of ISO 9001:2000 explains the PDCA cycle as follows:



- Plan Establish the objectives and processes necessary to deliver results in accordance with customer requirements and the organization’s policies
- Do Implement the processes
- Check Monitor and measure processes and product against policies, objectives and requirements for the product and report the results
- Act Take actions to continually improve process performance.

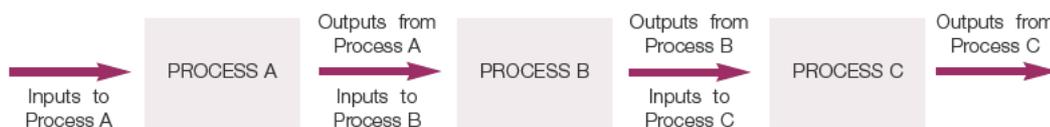
*The PDCA cycle*

### 2.3 Understanding the systems approach to management

Another of the eight quality management principles that is intimately linked with the process approach is the Systems approach to management, which states that: **Identifying, understanding and managing interrelated processes as a system contributes to the organization’s effectiveness and efficiency in achieving its objectives.**

The consulting engineering firm commonly deals with many interrelated processes in service provision, for example, customer communication, the preparation of an agreement, review and change of customer requirements, planning of services, purchasing of subcontracted services, design management, information and file management, invoicing and follow-up on completed work. A project management approach is commonly appropriate to manage the interactions of such processes, and to ensure that outputs (including changes) from one process are translated into inputs for associated processes.

The Quality Management System comprises a number of interrelated processes. The interdependencies of an organization’s activities can sometimes be complex, resulting in a network of various processes and sub-processes. Inputs and outputs of these processes relate to both external and internal customers. An example of a chain of interacting processes is shown in the figure below. The “Systems Approach to Management” allows for the coordination and compatibility of an organization’s planned processes, and a clear definition of their interfaces.



*Chain of interrelated processes*

## 2 ISO 9001 process approach to Quality Management Systems

### 2.4 Implementation of the process approach in relation to ISO 9001:2000 requirements

Clause 0.2 in the introduction of ISO 9001:2000 states, when referring to the process approach:

“When used within a quality management system, such an approach emphasizes the importance of

- a understanding and meeting requirements,
- b the need to consider processes in terms of added value,
- c obtaining results of process performance and effectiveness,
- d continual improvement of processes based on objective measurement.”

Further guidance is provided in Clause 2.3 of ISO 9000:2000.

Within the context of ISO 9001:2000, the process approach applies to all processes of the Quality Management System. All processes can be managed by using the “PDCA” concept.

Requirements for these processes are stated in the following sections of ISO 9001:2000:

- 4 Quality Management System
- 5 Management responsibility
- 6 Resource management
- 7 Product realization
- 8 Measurement, analysis and improvement.

The general requirements for a Quality Management System are defined in Clause 4.1 of ISO 9001:2000. Some guidance is given below on what questions an organization may choose to ask itself in order to address these requirements. It is stressed that these questions are only examples, and should **not** be interpreted as the only way to meet the requirements:

**a Identify the processes needed for the Quality Management System, and their application throughout the organization**

- What are the processes needed for our Quality Management System?
- Who are the customers for each process (internal and/or external customers)?
- What are the requirements of these customers?
- Who is the “owner” of the process?
- Are any of these processes outsourced?
- What are the inputs and outputs for each process?

**b Determine the sequence and interaction of these processes**

- What is the overall flow of our processes?
- How can we describe this? (process maps or flow charts?)
- What are the interfaces between the processes?
- What documentation do we need?

**c Determine criteria and methods required to ensure that both the operation and control of these processes are effective**

- What are the characteristics of intended and unintended results of the process?
- What are the criteria for monitoring, measurement and analysis?
- How can we incorporate these criteria into the planning of our Quality Management System?
- What are the economic issues (cost, time, waste, etc.)?
- What methods are appropriate for data gathering?

**d Ensure the availability of resources and information necessary to support the operation and monitoring of these processes**

- What are the resources needed for each process?
- What are the communication channels?
- How can we provide external and internal information about the process?
- How do we obtain feedback?
- What data do we need to collect?
- What records do we need to keep?

**e Measure, monitor and analyse these processes**

- How can we monitor process performance (capability of processes; customer satisfaction)?
- What measurements are necessary?
- How can we best analyse gathered information (statistical techniques)?
- What does the result of this analysis tell us?

**f Implement action necessary to achieve planned results and continual improvement of these processes**

- How can we improve the process?
- What corrective and/or preventive actions are necessary?
- Have these corrective/preventive actions been implemented?
- Are they effective?

## 2 ISO 9001 process approach to Quality Management Systems

### 2.5 Documentation of processes

ISO 9001:2000 requires that all processes “needed for the quality management system” be managed according to Clause 4.1 General requirements. There is no “catalogue”, or list of processes that must be documented. Each organization should determine which processes are to be documented on the basis of its customer and applicable regulatory or statutory requirements, the nature of its activities, and its overall corporate strategy.

In determining which processes should be documented the organization may wish to consider factors such as:

- Effect on quality
- Risk of customer dissatisfaction
- Statutory and/or regulatory requirements
- Economic risk
- Effectiveness and efficiency
- Competency of staff
- Complexity of processes.

Where it is found necessary to document processes, a number of different methods can be used, such as graphical representations, written instructions, checklists, flow charts, visual media, or electronic methods.

For further guidance on the documentation requirements of ISO 9001:2000, please refer to Appendix B.

## 3 Application of ISO 9001:2000 to consulting engineering services

### 3.1 Introduction

The ISO 9001:2000 standard requires that all the processes needed for the Quality Management System be planned, implemented and maintained. This includes what is termed in ISO 9001:2000 as product realization processes, i.e., the consulting engineering firm processes to provide services to clients. It is important to emphasize that the output of the consulting engineering firm is the “product” in terms of ISO 9001:2000. This is not to be confused with the product which may be produced on the basis of the consulting engineer’s output.

Engineering design is usually the dominant part of the service provided by the consulting engineering firm, and hence the design process is central to the firm’s operation.

Services, such as planning and feasibility studies, can be regarded as development. ISO 9001:2000 does not distinguish between “design” and “development”, and indeed for the consulting engineering firm, a single process can be used. Some other services may not fit in the “design and development” category, for example, tendering and contract services performed on behalf of customers, or inspection for conformance with specifications. The firm may also encompass other related services, such as surveying.

Each consulting engineering firm therefore needs to consider what processes it operates in providing its services. The scope of such processes may allow some requirements of ISO 9001:2000 to be excluded.

### 3.2 Scope of the Quality Management System

ISO 9001:2000 Clause 1, Scope, defines the scope of the standard itself. This should not be confused with the scope of application of the Quality Management System. For most firms, the Quality Management System will apply to all services provided. However some firms may decide not to cover all of their services, whether defined by service or by geographical area of operation. As an example, a firm may decide (at least initially) to limit the application of the Quality Management System to its civil engineering services, or to those services provided in its home country. In many cases, such restriction is used in order to place priority on certain

services or areas of operation, with the Quality Management System being progressively expanded to cover other services over a period of time.

If a consulting engineering firm chooses to implement a Quality Management System with a limited scope, this should be clearly defined in the firm’s *Quality Manual*, and any other publicly available documents (for example, certification/registration documents and marketing material). It is important to avoid confusing or misleading clients and other users.

### 3.3 Exclusions from the ISO 9001:2000

ISO 9001:2000 Clause 1.2, Application, permits exclusions of requirements in Clause 7 of the Standard that neither affect the firm’s ability, nor absolve it from its responsibility, to provide a product that meets customer and applicable regulatory requirements. Requirements from other clauses of the Standard must not be excluded.

Consulting engineering firms may find it advisable not to exclude any requirements, even if some do not currently apply. Each project is a new “product”, and new processes may need to be introduced for a particular project. The firm would not want to be constrained by stated exclusions in their *Quality Manual*.

Out of all the requirements of Clause 7, only those of Clause 7.6, Control of monitoring and measuring devices, should be considered for exclusion by consulting engineering firms. This clause should only be excluded if a firm does not use monitoring or measuring devices for any purposes, including indicative measurements, such as those used in monitoring construction activities.

Where devices such as measuring tapes and electrical meters are used only for indicative purposes, the parts of Clause 7.6 related to calibration of measuring equipment (paragraphs 3 and 4) may be excluded. However, whenever work of Contractors may be rejected by such measurement, the devices need be controlled in accordance with Clause 7.6.

### 3 Application of ISO 9001:2000 to consulting engineering Services

Some consulting engineering firms have suggested other clauses for exclusion:

For additional guidance on ISO 9001:2000 Clause 1.2, Application, please refer to Appendix B.

- Firms which carry out only design and development activities may effectively control all work under Clause 7.3, Design and development, and hence regard some of Clause 7.5, Production and service provision, as appropriate for exclusion. However rather than excluding these requirements, the firm should consider the requirements of 7.3 and 7.5 together, i.e., applying the methodologies and controls described in Clause 7.3 within the requirements of 7.5, thus taking all requirements into consideration, but avoiding duplication.
- Many consulting engineering firms consider that they should exclude Clause 7.3.6, Design and development validation, because design validation can only be completed after the product is produced or constructed. However, Clause 7.3.6 states that “wherever practicable” design validation should be conducted prior to delivery or implementation. In practice, some degree of design validation is commonly carried out at the design stage (though it may be combined with design review activities), and for some products significant design-stage validation may be necessary. It is therefore not appropriate to exclude this requirement.
- Regarding the provisions of Clause 7.5.2, firms may find that there are no processes that require validation. However, since project-specific processes may be developed when needed, it may be inadvisable to exclude this requirement.

## 4 Interpretation of ISO 9001:2000 requirements for the consulting engineering industry

The following sections of the Standard are explained in this part of the Guide:

- 4 Quality management system
- 5 Management responsibility
- 6 Resource management
- 7 Product realization
- 8 Measurement, analysis and improvement.

For Clauses 4.1 to 8.5 of the standard, the structure of the guidance is:

### Standard

Actual headings of the ISO 9001:2000 clauses.

### Purpose

A short description of what the clause means in terms relevant to a consulting engineering firm.

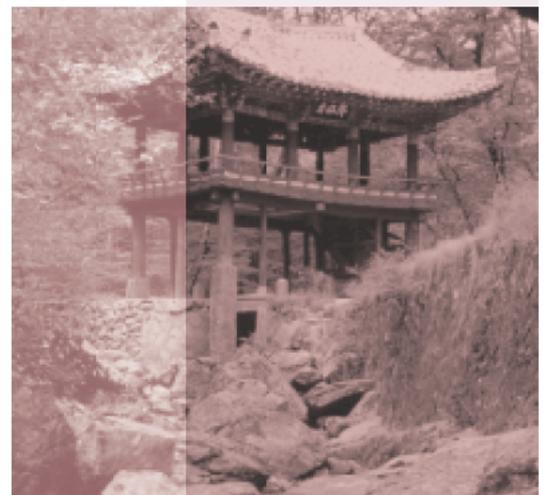
### Guidance

A discussion of the interpretation of that clause, and guidance to its application by consulting engineering firms.

Using the guide, it is recommended to first read the relevant clause of the ISO 9001:2000 Standard, and then to read the corresponding section in this chapter.

Under the heading **Guidance** the word *client*, i.e., the party with whom the firm has an agreement to provide services, is used where appropriate.

The Standard uses the word *customer*, which includes not only the client, but also other relevant persons or parties. For a consulting engineering firm, the term "customer" may include the client, regulatory agencies, end users and agents of the client. The customer may also be within the firm (internal customer).



## 4 Interpretation of ISO 9001:2000 requirements for the consulting engineering industry

### Standard

#### 4 Quality management system

##### 4.1 General requirements

### Purpose

To establish and continually improve a Quality Management System for an organization.

### Guidance

This clause establishes the general requirements for an organization to identify the processes needed for its Quality Management System, and to manage those processes within an effective system.

It is important to highlight the main value-adding process chain and how each process influences the ability to meet customer requirements for the service. It is also important to consider how processes relate to the management of risk, in order to ensure that the management controls of the firm are appropriate for the level of risk exposure.

The processes within an organization can normally be considered at various levels of detail. The extent of detailed description of processes is likely to depend upon factors such as:

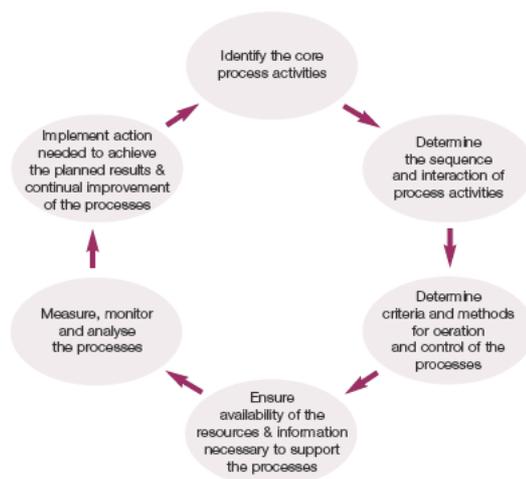
- The size of the firm and the type of activities
- The complexity of processes and their interactions
- The level of risk exposure
- The competence (level of education, training, skills and experience) of personnel.

The diagram below illustrates the application of the Clause 4.1 in an organization.

Consider the following aspects in the evaluation of the firm's processes:

- Identification and communication of customer requirements
- Identification of process objectives
- Process planning
- Establishment and documentation of responsibilities and authorities
- Availability of competent personnel
- Adequacy of resources and work environment
- Adequacy of documentation describing operational methods
- Monitoring of process performance against quality objectives and product requirements
- Control of nonconformity
- Application of corrective/preventive actions
- Evidence of continual improvement
- Availability of records

Appendix A of this document provides a sample list of processes in a consulting engineering firm in relation to the requirements of ISO 9001:2000. However, it is important that each firm considers its own method of operation and seeks to establish the optimum set of processes for achieving its business objectives. Where any processes are outsourced, the firm still needs to ensure control over such processes.



Application of Clause 4.1 General requirements

## 4 Interpretation of ISO 9001:2000 requirements for the consulting engineering industry

### Standard

#### 4.2 Documentation requirements

##### Purpose

To define what constitutes the Quality Management System documentation according to the standard.

##### Guidance

The standard requires documentation of the Quality Management System. The manner and extent of documentation will vary from firm to firm, reflecting factors such as the nature of the firm, its management policy and objectives, business and marketing plans, personnel, and the scope and complexity of the services it undertakes. The documentation should be concise and easy to use, and should communicate the quality policy, quality objectives, procedures, process descriptions and management style of the firm in a practical, realistic manner.

Although the standard sets out requirements under a number of headings, there is no obligation to arrange the documentation of a Quality Management System in this manner. System documentation is unique to each organization. It is preferable for the documentation to be arranged to reflect the organizational structure and the major processes performed in the firm. Where the headings and structure chosen are different from those in the standard, it can be helpful to include a table, matrix or cross-reference list when preparing the documentation.

Re: **Documentation required by the standard** (Clause 4.2.1)  
Includes:

a **Statements of quality policy and quality objectives.**

The quality policy is normally included in the *Quality Manual*. General quality objectives (i.e., quality objectives not related to a specific project) may be included in the *Quality Manual* or in the business planning documentation. Specific quality objectives for each assignment may be included in project quality plans.

b **A *Quality Manual*** (Clause 4.2.2).

The Manual should describe the system and how the requirements of the standard are addressed. Supporting documents such as organization charts may be included or referenced. The *Quality Manual* will be the head document of the Quality Management System. The Manual may be designed as a non-confidential document suitable for submission to clients and other external parties.

The content of a *Quality Manual* is described in the *FIDIC Guide to Quality Management*.

c **Documented procedures required by ISO 9001:2000.**

Documented procedures specify the way to carry out a process.

The following clauses of the standard specifically require documented procedures:

- 4.2.3 Control of documents
- 4.2.4 Control of records
- 8.2.2 Internal audit
- 8.3 Control of nonconforming product
- 8.5.2 Corrective action
- 8.5.3 Preventive action

## 4 Interpretation of ISO 9001:2000 requirements for the consulting engineering industry

Documents needed by the firm to ensure the effective planning, operation and control of its processes.

In order to implement an effective Quality Management System, a firm needs to establish sufficient documentation to support the management of all its processes.

Beyond those documented procedures specifically required by the standard, the firm itself must identify which processes need to be documented, and the nature of that documentation. Particularly in larger firms, additional organizational management processes may need to be documented as procedures, or supported by other process descriptions such as flowcharts, electronic workflow or working documents, that may become quality records on completion of the activity. Processes necessary to provide the services to the clients should be documented to the extent required to ensure effective planning, operation and control.

In a consulting engineering firm, the details contained in a process description depend on:

- The skills, experience and competency of the personnel
- The criticality of the process
- The sensitivity and complexity of the process
- The risk involved in case of a nonconformity
- How often the process is performed
- The need for consistency of the output
- The extent of the supervision/check required.

Documented procedures or other process descriptions are also helpful in training personnel. They should specify the functional workflow and relevant controls within the firm. Unnecessary duplication of documentation should be avoided.

The consulting engineering firm needs to consider documentation of both generic processes used by the firm and the application of those processes to particular projects, i.e.:

- Documented procedures and/or other documents supporting the management of generic processes
- Project-specific documentation, in particular project quality plans, setting out the planned activities, responsibilities, resources, processes and documentation to be used for a specific project. Where existing procedures or other process documents do not cover the full range of activities for a specific project, additional or modified documents may need to be prepared for inclusion in the project quality plan.

### e Records as defined in the documented procedure for control of records.

Records are documents stating results achieved or providing evidence of activities performed. In the consulting engineering firm, the requirements of the standard for records (Clause 4.2.4) are consistent with good practice for project records. Attention will need to be given to applying similar practices to records from management processes (see Control of Records below).

For additional guidance on documentation requirements of ISO 9001:2000, please refer to Appendix B.

## 4 Interpretation of ISO 9001:2000 requirements for the consulting engineering industry

Re: **Control of documents** (Clause 4.2.3)

The purpose of document control is to ensure that correct documents are available to those who need them, and that incorrect, unauthorised or superseded documents are not used.

Control means having a systematic, pre-planned approach to document preparation, identification, review, approval, distribution, availability, storage and change. This includes documents, computer software, and data generated, used, stored, and transmitted by using electronic means.

Documents covered by this clause include:

- Documents describing the operation of the Quality Management System (*Quality Manual*, procedures and other process descriptions, project quality plans)
- Contracts with clients, subconsultants and other collaboration partners
- Definition of inputs for realization of the project
- The result of the services – the deliverables
- Software used to perform the activities.

Master lists of documents or their equivalent are required for the practice or the project, so that current and superseded documents can be clearly and easily identified, and the issue of documents can be controlled or traced. The master lists needs to be kept up to date, and to include a record of changes.

External documents, including standards, codes of practice and regulations, need to be identified and their distribution controlled.

Re: **Control of records** (Clause 4.2.4)

Records need to demonstrate conformance with the standard and with specified requirements. Project records may be collected and maintained on a project-by-project basis under a general system of practice or office record keeping. A consulting engineering firm's records will largely relate to work carried out on individual projects for clients. Records will also be generated for management reviews, audits, corrective/preventive actions, staff training, purchasing and other support activities.

The types of record a consulting engineering firm may need to keep include:

- The results of the services – the deliverables (for example, final reports, approved drawings, specifications and final calculations)
- Purchasing documents
- Records demonstrating verification activities (for example, contract reviews, evaluation of suppliers, inspection/check of purchased items or services, design/project reviews, checks of documents, site diaries, review of changes, verification, validation and calibration)
- Records demonstrating operation of the Quality Management System (for example, audit results, management review minutes, nonconformance reports, and skills and competence status of the employees).

Important records should be kept in a secure place, and protected from physical damage and unauthorised access. Methods of record disposition should be established to ensure that the confidential nature of the records stored is preserved. It is important to ensure the integrity of records by ensuring that they are not corrupted or altered, either accidentally or intentionally. Back-up routines for records kept in electronic form should be included. It is good practice to keep a back-up of electronic records in a secure place outside the office, and to ensure that the software needed to access the records is maintained.

## 4 Interpretation of ISO 9001:2000 requirements for the consulting engineering industry

### Standard

#### 5 Management responsibility

##### 5.1 Management commitment

#### Purpose

To provide visible evidence that the firm and its top management are committed to quality and quality management.

#### Guidance

Visible leadership by top management is essential to the effective development, implementation, review and improvement of the Quality Management System. In this clause "top management" means the management of the firm and not the management of a project.

The clause states clearly how evidence of top management's commitment should be provided.

One very important aspect of commitment is ensuring that there are adequate resources both to carry out project responsibilities and to manage the operation of the Quality Management System. Feedback from staff can be used to evaluate the perception of top management commitment to quality, and to the Quality Management System.

### Standard

#### 5.2 Customer focus

#### Purpose

To define top management's responsibility in relation to meet customer requirements.

#### Guidance

This clause highlights the overall responsibility carried by top management to ensure that customer requirements are properly addressed, with the goal of enhancing customer satisfaction. This includes, in particular, the client, but also other customers, such as internal customers, regulatory agencies provided with information for consent processes, contractors as users of project deliverables, end users and members of the community associated with a project.

Top management must establish an organizational culture directed towards client focus, and an environment within the firm that can lead to client confidence and satisfaction, by implementing measures that ensure a focus on those issues. For the consulting engineering firm, it is important that client focus is emphasized in the leadership of projects, offices and engineering disciplines.

## 4 Interpretation of ISO 9001:2000 requirements for the consulting engineering industry

### Standard

#### 5.3 Quality policy

##### Purpose

To define top management's responsibility in relation to the firm's quality policy.

##### Guidance

The clause states clearly top management's commitment in relation to the quality policy.

The quality policy statement should express the firm's overall quality intentions and organizational goals. It should also provide the link between, on the one hand, business objectives and marketing strategies, and on the other hand, quality objectives and quality planning. The policy acts as the cornerstone of the Quality Management System. Both clients and employees should be able to hold top management accountable for their visible commitment to the policy.

The quality policy would normally state policies covering:

- Commitment to ascertaining and meeting client needs and expectations
- Scope of the Quality Management System's application within the firm
- Management's expectations of employees
- The general approach to achieving these objectives.

The quality policy should be authorised by the chief executive or a senior partner.

### Standard

#### 5.4 Planning

##### Purpose

To define the top management's responsibility in relation to quality objectives and Quality Management System planning.

##### Guidance

Top management has to decide for which functions and levels within the firm quality objectives should be established. It should be noted that the quality objectives should be measurable and consistent with the quality policy. Quality objectives should be defined both for the organization itself and for each project. Means of measuring achievement of quality objectives should be established.

At the organizational level, examples of quality objectives could be:

- Reduction in the incidence and cost of nonconformity
- Effective handling of clients' complaints
- Project performance characteristics such as reduced rework or increased productivity
- Improved client satisfaction
- Rate of repeat business.

For quality objectives related to projects, see Clause 7.1.

## 4 Interpretation of ISO 9001:2000 requirements for the consulting engineering industry

### Standard

#### 5.5 Responsibility, authority and communication

##### Purpose

To ensure that responsibilities, authorities and lines of communication are defined within the firm, and that they work effectively in practice.

##### Guidance

The output from a the consulting engineering firm is normally a service provided in a project organization, comprising a project team headed by a project leader/manager.

Re: **Responsibility and authority** (Clause 5.5.1)

Clear definition of responsibility, authority (i.e., power of decision) and lines of communication is essential. This requirement can be fulfilled by summaries of key positions which identify the management structure and record the responsibilities and authorities, often by using a simple organization chart, supplemented by a set of job descriptions setting out the roles, responsibilities and authorities for key positions, including the project leader/manager. Normally these key positions will be assigned on a project-by-project basis and documented in the project quality plan. Delegation of responsibility and authority during absences should be defined and documented.

Special attention should be paid to areas of overlap or gaps of responsibilities between positions.

The organization chart and job descriptions should be reviewed and updated regularly.

Re: **Management representative** (Clause 5.5.2)

A person involved in the management of the firm needs to be appointed to assume overall responsibility and authority for quality management, including implementation, operation and improvement of the Quality Management System. In order to exercise this authority effectively, the person needs a thorough understanding of the firm's business and operations, but can also have other responsibilities. For a large firm there may also be a need to delegate responsibility to persons who report to the corporate quality management representative, for example, managers at branch or site offices.

Management representatives may also be appointed for major projects. Reports and advice from the management representative, based on information and data gathered through the Quality Management System, provide an important input to the process of management review (Clause 5.6).

Re: **Internal communication** (Clause 5.5.3)

Note: The following is modified from Standards Australia Handbook HB 90.3 *Construction Industry – Guide to ISO 9001:2000*.

It is crucial to the success of a consulting engineering firm that people are fully involved in achieving the organization's objectives. Therefore management should actively encourage feedback and communication from all people within the firm. Effective processes should be established for communication at all levels, and in both directions.

This clause links to clause 6.2.2, Competence, awareness and training, which, amongst other things, requires the firm to ensure that employees are aware of the relevance and importance of their activities, and how they contribute to the achievement of the firm's quality objectives.

## 4 Interpretation of ISO 9001:2000 requirements for the consulting engineering industry

### Standard

#### 5.6 Management review

##### Purpose

To provide a strategic assessment of the Quality Management System to ensure its continuing suitability, adequacy and effectiveness.

##### Guidance

Management reviews must be performed by the executive management, such as senior partners, and not be delegated to persons who do not have the authority to commit the firm to action. Large firms should consider having a management review process which "cascades up", having sectional, divisional and corporate reviews. Large projects may need their own management review program as a part of their management strategy, bringing together the client and other parties involved in the project.

In most consulting engineering firms, a management review can be conducted effectively in a meeting, with the decisions and the actions to be taken recorded in the minutes.

The intervals at which management reviews of the Quality Management System are to be conducted should be defined in the Quality Management System documentation. Once a system is operating effectively, annual management reviews may be appropriate. However, management reviews may be more frequent during the implementation phase, or at other times, such as a change in key personnel or the nature of the firm, following a significant client complaint.

It is the intention of ISO 9001:2000 that quality management is incorporated within the business management of an organization. It is therefore useful to align management reviews with the business cycle, so that outputs of the review can be used in wider business planning.

The management review process should be documented. The documentation would typically identify:

- Reviews to be performed and their frequency
- Review agenda
- Participants and responsibility for convening review meetings
- Inputs required and responsibilities for the collation of information
- Method of documenting reviews, and how to follow up.

The firm also needs to ensure that the objectives and measures of effectiveness of the management system are communicated and understood throughout the organization. A variety of means may be used such as, training sessions, bulletins and forums to keep all personnel up to date, induction of new employees, newsletters, internal meetings and circulation of reports.

Communication within projects and discipline groups often needs specific attention to ensure that the firm is open to innovation, learns from its experience and captures the knowledge that it develops in the course of its work.

Communication is, of course, a two-way process. As well as communicating down the line, it is important that employees are able to communicate upwards. For this to be effective, the firm will need to have processes in place to enable and encourage feedback (for example, employee forums, suggestion boxes and good ideas programmes). More importantly, there should be an established culture that encourages and responds to suggestions from all levels of the firm.

The internal audit reports or summaries may in themselves constitute an appropriate means of communication to senior management. However, it may be preferable to present more focussed information to the relevant work teams.

Other types of information that will communicate effectiveness include:

- Trends in nonconformities
- Performance against the quality objectives (as referred to in Clause 5.4.1)
- The results of quality improvement tasks
- Findings of management reviews.

## 4 Interpretation of ISO 9001:2000 requirements for the consulting engineering industry

As well as reviewing evidence concerning the adequacy of the Quality Management System, the quality of deliverables and the achievement of customer satisfaction, it is very important for a consulting engineering firm to consider the issue of personnel training, and how the firm is to maintain capability for the work it does and plans to do. Reviews should assess the effectiveness of training and the benefits derived for projects, the practice, personnel and clients. The adequacy of physical resources and facilities should also be included in management reviews.

### Standard

#### 6 Resource management

##### 6.1 Provision of resources

### Purpose

To define what resources are needed to meet the stated requirements of the firm and its projects.

### Guidance

Resource management is essential for the consulting engineering firm. Resource requirements cover personnel, equipment, information, software, support services and facilities. A regular review of the resources required will enable forward planning and could be carried out in conjunction with the management review (for the firm as a whole) and the review of requirements (for specific projects).

Services are provided in project organizations. Work teams are frequently being formed and changed, depending on the actual demands. This requires a continual review of resourcing and flexible and quick response to resource issues. Responsibilities must be clearly defined for identifying resource requirements and allocating resources, so that the needs of all projects and activities can be met.

Unless the firm has the appropriate resources to deliver what the client requires, or is able to procure corresponding services, it should not promise what cannot be delivered or renegotiate the appropriate conditions (for example, more time or increased budget) to allow it to deliver what it is promising.

## 4 Interpretation of ISO 9001:2000 requirements for the consulting engineering industry

### Standard

#### 6.2 Human resources

##### Purpose

To ensure that the right personnel are in the right positions at any time, and that the personnel understand how they are to contribute to achieve the quality objectives.

##### Guidance

The competence of personnel in a consulting engineering firm has a direct bearing on the quality of the services provided. All activities that affect quality should be performed by people who have the necessary qualifications, training, experience, knowledge and skills, and who can be trusted to make sound professional judgements.

Compliance with this requirement can be demonstrated through:

- Job descriptions which specify competence requirements
- Records of the assessment process for new employees (assessment against defined position descriptions)
- Personnel records/curricula vitae. Personnel records should show qualifications, training and experience relevant to the work that may be required, and could include recognition of study undertaken as part of a continuing professional development programme
- Training programmes. A training programme should take into account existing skills and qualifications, the needs and complexity of the firm, specific training needed to perform assigned tasks (including regulatory requirements) and general Quality Management System training. Management training and general training, such as communication and interpersonal skills, can be as important as the technical and professional aspects of training. There may also be an opportunity to enhance personnel competence by training to meet changes in the market, or to expand into new areas of work
- Records of training
- Evidence of staff performance/development reviews.

In a consulting engineering firm, records of qualifications held by personnel, together with job descriptions and records of training, are normally an appropriate basis for assignment of responsibility and authority.

Typical methods for raising employees' awareness of their contribution to achieving the quality objectives could be:

- Introduction to the firm's quality policy when they are employed
- Team briefings at the start of a new project, including the presentation of the project quality plan and discussion of the project's quality objectives
- Recognising good quality work performance
- Reporting on nonconformities, and actively disseminating to employees information on why nonconformities occurred and how they were resolved.

## 4 Interpretation of ISO 9001:2000 requirements for the consulting engineering industry

### Standard

#### 6.3 Infrastructure

##### Purpose

To ensure that the necessary facilities to achieve the required services are available.

##### Guidance

Clause 6.3 emphasizes the need to ensure that supporting facilities are adequate to meet needs, both for organizational management and the provision of services to clients. The standard explicitly mentions hardware and software, supporting services and associated facilities.

The firm needs to identify infrastructure requirements through planning of both organizational processes (for example, the adequacy of hardware resources, the suitability of software used in design and the availability of appropriate reference information) and the facilities required for specific projects (for example, space, hardware, information and communication technology). As with human resources, the consulting engineering firm is likely to have various levels of infrastructure needs over time, and must take care that those needs are met.

### Standard

#### 6.4 Work environment

##### Purpose

To ensure that the working conditions are suitable to achieve the required services.

##### Guidance

Work environment, as defined in ISO 9000:2000, includes physical, social, psychological and environmental factors.

Consulting engineering firms are generally well aware of the impact of these matters on staff performance in the office environment. Workplace health and safety must be considered, including applicable regulatory requirements.

Consideration needs to be given to work environment issues (including workplace health and safety) for staff outside the office, for example, at project site offices or when carrying out site investigations. The requirements also apply to staff engaged on a contract basis.

## 4 Interpretation of ISO 9001:2000 requirements for the consulting engineering industry

### Standard

#### 7 Product realization

##### Purpose

To describe how the consulting engineering firm will get the work done.

##### Guidance

“Product realization” is the term used in the standard for the processes required to produce the product. The deliverables can be reports, specifications, drawings, surveys, bills of quantities and software packages. Many firms provide a range of professional services other than design, such as studies, inspection, advisory and project management services. The processes by which the firm carries out the full range of its services need to be planned, developed and implemented. Many of the processes needed are generic and apply to the conduct of all services.

“Design and development” in Clause 7.3, as it relates to the consulting services, should be interpreted as design and development services to be provided to the client. Consulting engineering firms carrying out design and development sometimes regard this as the whole of the service provided to clients. However such an approach can overlook some aspects of the service as the client sees it, in particular, the “release, delivery and post-delivery activities” referred to in Clause 7.5.1(f).

Clauses 7.1 to 7.6 should therefore be taken into account in planning the processes required to provide the firm’s services. For design and development services, the firm should consider the requirements of Clauses 7.3 and 7.5 together, i.e., apply the methodologies and controls described in Clause 7.3 within the requirements of 7.5. However, it is important to have a clear understanding of the whole service to the client, including:

Communication matters such as progress reporting and the presentation of deliverables

- Direct advisory services
- Project completion actions, such as the care of closed project files.

The key generic processes for service provision will generally need to be documented. Depending on the size and complexity of the firm, these may be simple flow charts or more detailed documents. Unique project requirements can be set out in a project quality plan, which can also reference generic processes.

### Standard

#### 7.6 Planning of product realization

##### Purpose

To describe how the consulting engineering firm is going to set up the processes for the conduct of the consulting services.

##### Guidance

As a basis for planning the services provided to clients, the consulting engineering firm needs to identify clear quality objectives (Clause 5.4.1). These may include objectives applicable to all projects (for example, reduced rework), and objectives identified for individual projects.

The firm needs to have a planned approach to achieve the quality objectives set out for the services. Compliance with Clause 7.1 requires action at two levels:

- Planning and development of generic processes, documented within the Quality Management System
- Planning and development related to a specific project. This is usually documented in the form of a project quality plan for each project (or set of services). Guidance on project quality plans is provided in the *FIDIC Guide to Quality Management in the Consulting Engineering Industry*.

The planning should reflect that a consulting engineering service is often one-of-a-kind, developed in an iterative process, with the output detailed more and more as the project progresses. Usually, the client is involved in the project planning process. The level of client involvement may depend on the nature of the project and the relevant expertise of the client. Client involvement may be facilitated by dividing the project into phases, with the client approving the result after each phase, and by scheduling regular meetings with the client to discuss suggestions/possibilities.

Unusual conditions for the particular project should be identified and addressed in the planning activities.

In planning a particular project, the necessary resources should be identified, and the firm should ensure their availability.

## 4 Interpretation of ISO 9001:2000 requirements for the consulting engineering industry

### Standard

#### 7.2 Customer-related processes

##### Purpose

To make sure that:

- The consulting engineering firm and the client share a common understanding of what is to be done
- The consulting engineering firm understands and can meet the client's requirements
- All other relevant requirements are identified
- Proper communication with the client is established and maintained.

##### Guidance

The consulting engineering firm needs to determine the client's requirements, both those explicitly expressed and implied. It is often not possible to rely on requirements as defined by the client, for example, in tender documents, since these are unlikely to cover all statutory and regulatory requirements, applicable standards, or requirements which are the responsibility of the consulting engineering firm. Further, the client may not be able to identify and formulate the needs into requirements. It is critical that the consulting engineering firm takes adequate steps to clearly identify all requirements.

Determining requirements may be progressive. Establishing client requirements, developing a brief, and interacting with the client and other parties, to achieve and maintain documented agreement as the project evolves, can be a major task for a consulting engineering firm.

The review of the requirements should be done, as far as is practically possible, before the consulting engineering firm commits itself to accepting the work. This may not always be possible. It may be necessary and important in order to have a shared understanding of what is to be done, that the review process be extended to contract negotiations and post-award communications with the client. Special attention should be paid to the information that the client agrees to provide, and the client's involvement during the conduct of the project.

The process for preparation, review and approval of a proposal or contract submission, and the records to be maintained, generally needs to be documented in a procedure or other process description.

### Standard

#### 7.3 Design and development

##### Purpose

To translate the client's requirements into project specific design or development documents. This includes:

- **Planning:** to describe how the firm is going to plan the processes for the conduct of design and development activities of the project
- **Input:** to identify what input information is essential for the conduct of the project
- **Output:** to define the project deliverables
- **Review:** to confirm that the project efforts to date have produced the expected results
- **Verification:** to ascertain whether the project results meet the project input requirements
- **Validation:** to ascertain the project result can be expected to fulfil requirements for its intended purpose
- **Changes:** to control any changes to the project.

##### Guidance

Re: **Design and development planning** (Clause 7.3.1)

Reference is made to the guidance to Clause 7.1.

Re: **Design and development inputs** (Clause 7.3.2)

The clause is self-explanatory.

Re: **Design and development outputs** (Clause 7.3.3)

The clause is self-explanatory.

## 4 Interpretation of ISO 9001:2000 requirements for the consulting engineering industry

### Re: Design and development review (Clause 7.3.4)

Review is the formal evaluation of the project work, to confirm that it meets the client's needs and other input requirements, to identify if there are any problems, and to develop solutions for these problems.

Reviews can take place throughout the project. Their frequency is a function of the size and complexity of the project, and/or specified in the contract. The project team should decide what the appropriate stages for reviews are, the scope and objectives of the reviews, and the persons who should be involved in them. A complex project may require many reviews, and may need to include additional experts from within the firm, as well as external experts and client representatives. A simple project may require only one review. For small projects, such as those not involving subconsultants or other design groups, one person may conduct the review. Details of the planned design reviews should be incorporated into the project quality plan.

The review should identify and anticipate problem areas, and should initiate actions to ensure that the deliverables meet client requirements. A review should consider aspects such as client requirements, sequence of design activities, compliance with the design brief, identification and control of interfaces, construction processes, safety and methods of verification.

Records of the project review and any necessary actions must be kept. A record of review could be, for instance, notation on a document, minutes of a meeting, or a checklist signed off by the review leader.

### Re: Design and development verification (Clause 7.3.5)

Verification is an activity designed to ensure that the output to date meets the specified requirements.

All document (calculations, drawings, specifications, bill of quantities, reports, data sheets, etc.) produced as the result of the activities in the project should be verified before being issued. The verification of the documents should be performed by authorised personnel having the competence and ability to operate effectively, without being constrained in any way. In the case of multidisciplinary documents, the verification may involve persons of various disciplines. Verification checklists, or other working documents, may be appropriate to support particular verification activities. The verification may be more or less sophisticated, according to the project needs. The use of models, prototypes or computer simulations may be appropriate. Evidence of the verification, and any necessary actions, should be recorded.

The verification of individual documents, even carefully done, may be insufficient to ensure the adequacy of the entire project, and should be considered as a supplement to project reviews.

The verification should, to the extent necessary, cover interface aspects, constructability of the project, safety, reliability, environmental aspects, maintainability, operability, availability, and feasibility.

## 4 Interpretation of ISO 9001:2000 requirements for the consulting engineering industry

Re: **Design and development validation** (Clause 7.3.6)

Validation of the project is the process of ensuring that the physical product (for example a bridge or a plant) will or does meet the client's needs or the intended use.

Clause 7.3.6 requires that wherever practicable, validation should be carried out before delivery or implementation of the product. For the majority of assignments undertaken by a consulting engineering firm, such as a design assignment or a feasibility study, validation of the output can usually only be completed, when the physical object of the design or study has been realized.

Where proven design solutions are applied, there may be no need for further design validation. However it should be noted that the use of proven designs may not necessarily guarantee that all possible situations for the use of the product have been considered. Validation of designs against various possible future uses of the product may be included in design reviews.

Where unproven designs are developed, arrangements for validation need to be established, whether during the design period, during the product realization phase or later.

Responsibility for validation may rest with the consulting engineering firm or with others, depending on the scope of the contract. Where unproven design solutions are to be developed, it may be necessary for the consulting engineering firm to reach agreement with the client, during the contract negotiation phase, about the scope of design validation requirements within a contract.

When validation is within the scope of the consulting engineering firm's work on a particular project, the validation activities to be performed should be identified in the project quality plan. Adequate records of the validation process, including records of any necessary actions, should be maintained. Records of such validations may provide a source of proven designs for future use.

Re: **Control of design and development changes** (Clause 7.3.7)

When changes are made to a project, evidence of why the changes were made, the change itself, any reviews performed and who approved the changes must be documented.

The firm should establish methodology for the control of project changes. This methodology should include how changes, occurring due to the client's request, internal and external reviews or verification activities, are initiated, recorded, reviewed, approved and implemented. The persons authorised to approve project changes should be identified.

The methodology should provide for the timely availability of approved changes to holders of the original material.

The complexity of change management will depend on the scale and complexity of the particular project. During the planning of the project, decisions should be made about whether or not a comprehensive change register will be required, and how data should be recorded to enable sufficient monitoring and control.

## 4 Interpretation of ISO 9001:2000 requirements for the consulting engineering industry

### Standard

#### 7.4 Purchasing

##### Purpose

To ensure that any goods or services from outside the consulting engineering firm contributing to the quality objectives conform to the specified requirements, at both organizational and project levels.

##### Guidance

Re: **Purchasing process** (Clause 7.4.1)

The consulting engineering firm should have a process description for purchasing those goods and services which may affect the quality of the services. The most important application of this clause in a consulting engineering firm is the selection, use, control and review of subcontracted services to projects.

Provision of procurement services to clients may apply some of the principles of this clause, but the consulting engineering firm may not have control of all aspects of the process. Such services should be controlled under the provisions of Clause 7.5, as the output is a deliverable to the client.

The consulting engineering firm should be able to identify those purchased goods and services that may affect service quality. The firm must then be able to purchase these goods and services from a supplier who is able to meet the requirements. Generally this will be a supplier who has been qualified according to the firm's selection criteria. The criteria for such qualification could include among others the following:

- References
- Past experience
- Evidence of implementation of a Quality Management System.

The type and extent of control that should be applied to purchases should be determined. For consulting engineering firms, this applies particularly to subcontracted services, where specific controls are required. The process for submission and acceptance of subcontracted services should be documented in the project quality plan and, if necessary, in the contract with the supplier.

A record of the supplier evaluation should be kept.

Re: **Purchasing information** (Clause 7.4.2)

For purchasing goods and services that may affect service quality, the firm should prepare written specifications for the goods or services being purchased, and ensure that the purchase orders are appropriately authorized. If the firm's client wishes to inspect the goods or services at the supplier's premises or point of supply, arrangements for this need to be established.

Re: **Verification of purchased product** (Clause 7.4.3)

The firm should define appropriate measures to verify that the goods or services are capable of contributing to the quality objectives, and are in accordance with the requirements. The verification can be performed for example by:

- Check at the supplier's place of business before delivery (arrangements to permit this to happen, and all associated details, need to be incorporated into the purchase order)
- Check at receipt of the goods or services
- Check before being incorporated into the services to be provided to a client
- Joint review with the supplier.

Such verification should be recorded.

## 4 Interpretation of ISO 9001:2000 requirements for the consulting engineering industry

### Standard

#### 7.5 Production and service provision

##### Purpose

To ensure that all service provision processes meet client requirements.

##### Guidance

Re: **Control of production and service provision** (Clause 7.5.1).

Consulting engineering firms can find it useful to apply this clause to the management of the overall service to the client, so that job set-up, administration, coordination and reporting activities can be integrated with the determination of client requirements, design and related work.

Control of design and related services should be performed by applying methodologies and controls as described in Clause 7.3.

Specific processes that do not fit the generic design and development process also need to be developed in compliance with this clause. Examples include calling and evaluation of tenders, selection and engagement of contractors, and contract administration.

Re: **Validation of processes for production and service provision** (Clause 7.5.2).

Some projects may require certain processes, for example inspection tasks that cannot be verified after completion. In the consulting engineering industry, the most common method used of demonstrating that such processes are under control is the use of suitably qualified and competent personnel, together with a proven methodology. The retention of appropriate records is necessary to provide evidence that the planned arrangements have been fulfilled.

Re: **Identification and traceability** (Clause 7.5.3)

In a consulting engineering firm this aspect is normally covered by clause 4.2.3, Control of documents.

Re: **Customer property** (Clause 7.5.4).

This requirement needs to be applied in particular to intellectual property and confidential information provided by the client. This applies to commercial and organizational information related to the client, as well as information, software or other items provided as inputs for the services to be provided.

Re: **Preservation of product** (Clause 7.5.5)

Applies to project deliverables and is self-explanatory.

## 4 Interpretation of ISO 9001:2000 requirements for the consulting engineering industry

### Standard

#### 7.6 Control of monitoring and measuring devices

##### Purpose

To ensure that the monitoring and measuring devices, used by the firm, are functioning properly, and give correct results.

##### Guidance

Clause 7.6 addresses monitoring and measurement devices to provide evidence of conformity of the product. A consulting engineering firm does not normally use monitoring and measuring devices for this purpose. However it is advisable to use the same provisions for devices used for establishing data inputs, which is common for consulting engineering firms (for example surveys or checks on site of a contractor's measurements). In this case, the devices used should be controlled according to Clause 7.5, adopting the methodology of Clause 7.6.

Reliability of measurement is assured by using equipment of known accuracy. The equipment needs to be verified as being serviceable for use (in good working order), and calibrated periodically to confirm its continuing capability to meet the measurement accuracy for its application. "Periodically" can mean on a time basis (for example, monthly or annually) or on a usage basis (for example, before each use for infrequently used equipment). Verification can usually be done by the user according to a written instruction developed by the consulting engineering firm, or supplied by the manufacturer of the equipment. Calibration is often done by qualified external agents against a traceable reference standard.

Documented processes for the control of monitoring and measuring equipment should be established. To ensure that the equipment operates effectively and gives reliable results, the documented process should address the following:

- Methods to ensure that the equipment is suitably looked after (for example, correctly handled, stored and maintained), regularly checked, adjusted, verified and calibrated, as necessary
- Maintenance of records, showing the control of the equipment and, if applicable, that calibration is traceable to national or international standards
- Means of identifying the calibration status and suitability of the equipment for use. This may be achieved by labelling the equipment or by provision to the user of calibration records
- Action to be taken if the equipment is found not to conform to requirements, including review of prior measurements made with the equipment, when it was possibly faulty.

### Standard

#### 8 Measurement, analysis and improvement

##### 8.1 General

##### Purpose

To establish how well the firm is doing, in order to do better.

##### Guidance

It is recognised and generally accepted that to stay ahead, processes and practices must be continually improved to meet changing expectations, both from the client and the consulting engineering firm itself. To achieve this, persistent assessment of performance is required through collection and analysis of data, development and implementation of improvement initiatives, and the assessment of how effective those initiatives have been.

Clause 8.1 sets out the general requirement to the consulting engineering firm to identify, plan and implement monitoring, measurement, analysis and improvement processes, and prepare documentation to describe these processes.

## 4 Interpretation of ISO 9001:2000 requirements for the consulting engineering industry

### Standard

#### 8.2 Monitoring and measurement

#### Purpose

The purpose of this clause is to:

- Obtain information on how satisfied the client is with the services provided
- Determine the effectiveness of the Quality Management System
- Check that services are in accordance with the requirements, before delivery to the client.

#### Guidance

Re: **Customer satisfaction** (Clause 8.2.1)

The satisfaction of clients is an indicator of both the performance of the Quality Management System and business effectiveness. The consulting engineering firm should monitor client perception of the effectiveness of fulfilling the requirements. The information gained from client feedback can be very valuable for a consulting engineering firm, which can benefit significantly from client loyalty and return business.

In the engineering consulting industry, it is common to have very close relationships with the client. This close working relationship can make the idea of measuring and monitoring client satisfaction in a systematic manner a difficult concept to grapple with, because the firm responds to the clients' expression of satisfaction/dissatisfaction every day. It may be common in these situations to have a strong perception of how satisfied the client is. Unfortunately, this perception may be wrong.

Direct measurement (for example, by interviews, questionnaires or meetings) and indirect measurement (for example, by monitoring client complaints or loss of established clients) can be used to measure and monitor client satisfaction. Each method has advantages and disadvantages, and each consulting engineering firm must decide which methods are to be used generally in the firm, and towards each individual client.

Firms may choose to conduct regular surveys of client satisfaction, perhaps at the close of each project, or at intermittent intervals for long-term client relationships. It is not acceptable to limit assessment of clientsatisfaction to just evaluating client complaints.

Re: **Internal audit** (Clause 8.2.2)

The importance of the internal audit process is recognised in the standard by the requirement for a documented procedure. Audits should determine whether the Quality Management System is effectively and suitable for achieving the quality policy and the stated quality objectives. The results of the audits provide valuable information for effective management review and for corrective, preventive or improvement actions, and provide an opportunity for review, improvement and staff training.

A program for conducting internal audits should be prepared. Such a program could be established on a yearly basis, taking account of the result of the previous audits, management reviews, complaints, nonconformities, and business action plans. Audits should be conducted both at the organizational level and the project level.

An audit should comprise the following key phases:

- **Planning.** The auditor familiarises himself or herself with the subject to be audited. An audit plan and a checklist of questions to be prepared
- **Conducting.** The auditor seeks evidence to each of the pre-planned checklist questions
- **Reporting.** The auditor reviews the results, and reports the findings to the management controlling the work under audit
- **Follow-up and verification of actions taken.** Management responsible for the audited area should ensure that the are effective, and that results are recorded.

## 4 Interpretation of ISO 9001:2000 requirements for the consulting engineering industry

Audits should be carried out by someone who is not directly responsible for the area being audited. For small consulting engineering firms, it may be difficult to fulfil this and the firm may need to contract an external party to perform at least some part of the internal audit programme.

Re: **Monitoring and measurement of processes** (Clause 8.2.3)

This clause applies both to product realization processes (Clause 7) and other processes involved in the Quality Management System. Consulting engineering firms need to monitor that these processes are performing as planned, and take appropriate action to correct and/or control nonconformities. The concept of process monitoring is similar to project management, and hence should be readily applied by consulting engineering firms. However, particular attention will be required to applying this concept to management, as well as project processes.

Re: **Monitoring and measurement of product** (Clause 8.2.4)

Monitoring and evaluation activities related to consulting services should be included in the project quality plan. This will include design verification and validation activities (see Clause 7.3), and other monitoring activities, such as post-contract reviews with clients and project teams.

### Standard

#### 8.3 Control of nonconforming product

##### Purpose

To fix an identified problem.

##### Guidance

This clause covers services not in accordance with client requirements.

Requirements for the control of nonconforming product apply to all services provided and outputs produced by the firm. For design work, its primary application is to ensure that faulty work is not used, particularly for work released beyond the firm or design group. These provisions also apply to output from subconsultants.

Design and development (Clause 7.3) provides opportunities for detecting design errors or omissions during design verification and review activities. Any errors or omissions will be marked up and corrected before the design output is finalised. Such errors identified during the iterative design and development process are usually only considered as nonconformities, if they have been caused by deficiencies in the Quality Management System. Such nonconformities may be caused, for example, by lack of competent resources, inadequate subcontractor or supplier performance, or a breakdown in procedures for controlling the quality of the work.

Errors or omissions identified after the deliverables have been approved should be considered as nonconformities and handled according to this procedure.

Where rectification of the design errors or omissions would require a departure from client requirements, the nonconformity should also be handled as a design change (Clause 7.3.7).

## 4 Interpretation of ISO 9001:2000 requirements for the consulting engineering industry

### Standard

#### 8.4 Analysis of data

##### Purpose

To utilise the valuable information obtained from monitoring and measurement, internal audits, nonconformities, reviews, verifications and any other information about the effectiveness of the Quality Management System.

##### Guidance

Given that the products of the consulting engineering firm are generally limited to the outputs of a one-off project, the collection and analysis of product data has limited application. Similarly, product realization processes, generally defined in a project quality plan, are usually applied in a unique manner to each project. However, in some instances, data may be collected for improvement initiatives on organizational level or on project level.

Suppliers, for example subconsultants, provide a series of unique services. However, satisfaction with such suppliers can be monitored, and data collected as a basis for evaluating future use.

Conclusions drawn from analysis should be objective, or clearly identified as subjective. Note that objective conclusions can be made from data which is itself subjective or qualitative, such as clients' perceptions of quality or a project team's view on the project execution.

### Standard

#### 8.5 Improvement

##### Purpose

How to utilise the data analysis performed according to Clause 8.4 for improvement, including the repair of causes to an identified problem and finding problems before they occur.

##### Guidance

Re: [Continual improvement](#) (Clause 8.5.1)

The output of data analysis may be used to identify opportunities for improvement. The firm needs to be able to show evidence of efforts to improve the effectiveness of the Quality Management System. This may be done through specific initiatives undertaken to meet quality objectives both at the organizational level and at the project level and/or by changing the quality policy and the quality objectives.

## 4 Interpretation of ISO 9001:2000 requirements for the consulting engineering industry

Re: **Corrective action** (Clause 8.5.2)

This clause deals with the analysis of an actual nonconformity, in order to prevent the reoccurrence of the problem.

The need for corrective action may become apparent from work that does not meet requirements, a client complaint, an audit, or a management review.

Re: **Preventive action** (Clause 8.5.3)

The purpose of preventive action is to predict possible or potential problems in the Quality Management System, and to implement changes to eliminate such problems before they occur.

Preventive action can be more difficult to address than corrective action, because the firm is trying to anticipate circumstances that are likely to cause nonconformities, rather than responding to events or problems.

One way of addressing preventive action is to see it as risk management. This should be done both at the organizational level and at the project level. Implementing risk management could be one (important) preventive action, allowing focus on potential aspects that may lead to nonconformities.

Another way of addressing preventive action is to review existing data for trends, for example:

- The operation of the Quality Management System
- The results of design evaluation activities
- Feedback from clients and staff
- The effects of changes in technology.



## Appendix A

# Example: Processes relating to ISO 9001:2000

The following list outlines processes that may typically need to be described in providing consulting engineering services. For ease of reference in Section 4 of this Guide, the processes are listed broadly under the main clauses of ISO 9001:2000, with clause references in brackets. However, some processes address requirements in other sections, in order to provide a practical sequence of activities.

The processes should be divided or combined in ways to suit each firm's operation. In small firms, the processes suggested below may be able to be amalgamated to reduce complexity, particularly those listed under Clause 7. The opposite may be true in larger firms. There is no requirement to maintain processes in accordance with the structure of the Standard or the suggestions of this Guide.

### Clause 4 Quality Management System

- Control of Quality Management System documents (Clause 4.2.3)
- Control of files and records (Clause 4.2.4)

### Clause 5 Management responsibility

- Management system planning (including Clauses 4.1, 4.2.1, 4.2.3, 5.1 – 5.5, 6.1 – 6.4 and 8.1)
- Management review (Clause 5.6)

### Clause 6 Resource management

- Competence and training (Clause 6.2.2)

### Clause 7 Product realization

- Defining requirements, including:
  - Defining work requirements for particular project (Clause 7.2.1)
  - Pre-submission review of requirements and capacity to supply (Clause 7.2.2)
- Agreeing on terms and conditions with customers
  - Managing service provision, including
  - Post-award review of requirements and resources for supply (Clause 7.2.2)
  - Work planning and preparation of project quality plans (Clauses 7.1, 7.3.1, 8.2.3 and 8.2.4)
  - Managing customer and other interested party communication (Clause 7.2.3)
  - Coordinating design and development and purchasing activities (see below)
  - Managing delivery of services (Clause 7.5)
- Design and development (Clause 7.3)
- Purchasing, including:
  - Control of subconsultant and contract services (Clause 7.4)
  - General purchasing control (Clause 7.4)
  - Procurement services to clients (Clauses 7.4 and 7.5)
  - Contract management services to clients (Clauses 7.4 and 7.5)
- Control of monitoring and measurement devices (Clause 7.6)

### Clause 8 Measurement, analysis and improvement

- Monitoring customer satisfaction (Clause 8.2.1)
- Internal audit (Clause 8.2.2)
- Corrective action and improvement, including:
  - Control of nonconformity (Clause 8.3) if not covered in "Managing delivery of services"
  - Corrective and preventive action (Clauses 8.5.2 and 8.5.3)
  - Analysis and improvement (Clauses 8.4 and 8.5.1)

## Appendix B

# References and further reading

ISO 9000:2000 Quality Management Systems - Fundamentals and Vocabulary

ISO 9001:2000 Quality Management Systems - Requirements

ISO 9004:2000 Quality Management Systems - Guidance for Performance Improvements

FIDIC *Guide to Quality Management in the Consulting Engineering Industry*, June 2001

FIDIC *Training Kit on Quality Management in Consulting Engineering*, June 2001

Standards Australia HB 90.3 *The Construction Industry Guide to ISO 9001:2000*

International Organization for Standardization (ISO) web site at [www.iso.ch](http://www.iso.ch)

Contains the following information that is recommended for reference:

- Quality management principles
- Frequently Asked Questions
- Transition Planning Guidance for ISO 9001:2000
- ISO 9000:2000 – Selection and Use
- Guidance on ISO 9001:2000 Clause 1.2 “Application”
- Guidance on documentation requirements of ISO 9001:2000
- Guide to the terminology used in ISO 9001:2000 and ISO 9004:2000
- Guidance on the process approach to Quality Management Systems

Information about FIDIC publications is available at [www.FIDIC.org/bookshop](http://www.FIDIC.org/bookshop), where publications can be purchased.

FIDIC maintains a clearing house of resources dealing with quality management in the consulting engineering industry at [www.FIDIC.org/quality](http://www.FIDIC.org/quality)





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