

**Zeitschrift:** IABSE reports = Rapports AIPC = IVBH Berichte  
**Band:** 51 (1986)

**Artikel:** Quality assurance in a major consulting engineering company  
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**DOI:** <https://doi.org/10.5169/seals-39600>

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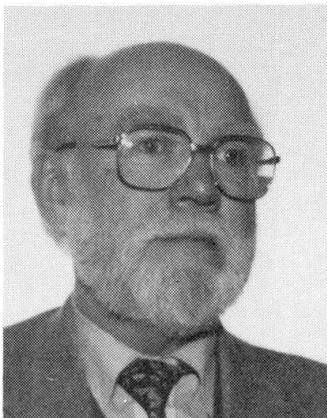
## Quality Assurance in a Major Consulting Engineering Company

Assurance de la qualité au sein d'une société importante d'ingénieurs-conseils

Qualitätssicherung in einer grossen Ingenieur-Unternehmung

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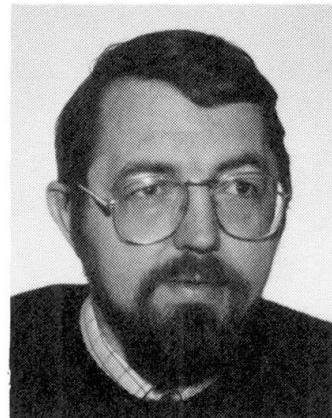
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### SUMMARY

This paper outlines how the concept of quality assurance has been adopted and interpreted in a consulting engineering company. Selected elements of the quality assurance system, such as organization, document control, and audits are described in detail.

### RÉSUMÉ

Le présent document décrit la manière dont la conception de l'assurance de la qualité a été adoptée et interprétée au sein d'une société d'ingénieurs-conseils. Des éléments du système de l'assurance de la qualité tels que l'organisation, la vérification et la révision des documents, sont décrits en détail.

### ZUSAMMENFASSUNG

Der vorliegende Beitrag beschreibt die Formulierung und Interpretation eines Qualitätssicherungs-Konzepts in einer Ingenieur-Unternehmung. Ausgewählte Elemente dieses Systems zur Qualitätssicherung, wie Organisation, Dokumentation und Qualitäts-Audit, werden im Detail dargelegt.



## 1. INTRODUCTION

Cowiconsult, Consulting Engineers and Planners, is an independent Danish company founded in 1930.

The company operates on a worldwide basis with planning, design, supervision and management of projects within all major engineering fields. Among others also civil and structural engineering.

Cowiconsult has a total permanent staff of more than 900 people, of whom some 600 are graduates from universities, and the company have rendered consulting services in more than 60 countries, mainly in Europe, Africa, the Middle East, and East Asia.

The paper outlines the means utilized to ensure the quality of the projects undertaken. The methods used in the past are described, and it is discussed in detail how the modern concept of quality assurance is interpreted, introduced and implemented.

It is and has always been a main objective of Cowiconsult to render engineering services of high technical standard and the company has therefore aimed at adapting its quality assurance system to the changing demands.

## 2. QUALITY ASSURANCE IN THE PAST

Certain means have always been established to assure the quality of the projects, and they will continue to form a fundamental part of any quality assurance system.

The management has always recognized that the professional qualification of the employees are of fundamental importance to quality. Comprehensive training and postgraduate programs are carried out, and close contact with colleagues, other companies and research institutes all over the world have been established to keep the employees and the company up-to-date with the technical development.

Instructions, manuals and guidelines have been established to define the engineering practice to be adhered to by the engineers and planners. Emphasis has been placed on checking activities to ensure that the documents prepared actually fulfill the design basis and meet the company's engineering practice.

## 3. WHY CHANGE THE QA SYSTEM

The means described in Section 2 are sufficient for smaller companies covering only a few disciplines, and where one person is able to conduct and understand all activities involved in a project.

Often this is not the situation anymore.

Gradually it has become evident that the concept adopted to assure the quality should be re-evaluated due to the following:

- The number of disciplines undertaken have increased rapidly in the last 10 years, which has required changes in the traditional organizational structure.
- Generally, the projects are becoming more and more complex, encompassing - among other things - oil and gas facilities both onshore and offshore.
- The consequences, both economic and safety-wise of possible omissions or negligence, are increasing with the complexity and size of the projects.
- Experience has shown that mere checking of documents does not always lead to the expected results.

- It is more and more common that clients, especially within the oil and gas industry, require a documented quality assurance system in accordance with quality assurance standards recognized, implemented by their consultants and contractors.

It should be realized that it is not possible to check quality into a design document. Quality has to be introduced, primarily through the original design process, into it. Consequently, a certain number of parameters must create and influence the quality. If we are able to identify and control these parameters, we should be able to design the project to the required standard, the right quality. This is exactly what the modern concept of quality assurance is aimed at.

Basically, this means that some resources are moved from the "back end" of the engineering process, where one only registers what has actually been done to the "front end", where one can plan, monitor, and influence the activities to be performed. The resources are changed from being passive to being active in the engineering process.

Generally the major decisions in a project are taken at an early stage, and the resources spent in the concept and planning phase to identify the basis and the expected outcome and to plan the project implementation are of utmost importance to the success of a project.

#### 4. HOW TO ESTABLISH THE QA SYSTEM

The first problem is to define the quality policy.

What do we actually mean by quality in relation to the services rendered by a consulting engineering company? We have to ask ourselves questions such as:

- Is a six-lane motorway in Denmark of a higher quality than a dirt road in Africa?
- Is a detailed design of a higher quality than a basic design?

We ended up with the following quality policy of the company:

"Every project undertaken must be carried out in such a way that:

- it meets the client's needs,
- the technical quality of the project is acceptable,
- the contract is fulfilled, and
- account is taken of social and environmental considerations."

With this definition, it is evident that the dirt road in Africa may have a higher quality than the motorway in Denmark - it depends on the needs.

All four statements have to be fulfilled as a prerequisite for the success of a project.

Having reached this fundamental definition, the phases for establishing the quality assurance system are as follows:

1. Identification of the parameters influencing the quality of the services to be rendered.
2. Definition of the overall requirements of the parameters, "the means", in a quality assurance manual.
3. Acceptance of the commitments in the manual by the management.
4. Definition of procedures necessary to fulfil these commitments.
5. Identification and review of existing procedures.
6. Preparation of missing procedures.



## 7. Information and training of employees in the quality assurance concept.

In Cowiconsult's process of introducing the QA-system the first five phases are completed and the last two phases are expected to be fully implemented by the end of the year.

## 5. DESCRIPTION OF THE SYSTEM

The quality assurance manual describes the means employed in the company to fulfil the quality policy. The list of contents is as follows:

Preface

0. Quality Basis

1. Basic Organization

2. Project Organizations

3. Activity Planning

4. Aim and Criteria of Projects

5. Planning and Execution of Projects

6. Document Control

7. Changes in Projects

8. Corrective Actions in the Event of Errors/Faults

9. Quality Audit.

The obligations given in the manual are further elaborated in procedures related to the means mentioned. Procedures are detailed to such an extent that different persons with sufficient qualifications will reach the same correct result when using these procedures. This will leave the engineer more time for the more essential engineering activities: to reach appropriate solutions to technical problems.

Generally, a procedure consists of instruction sections giving rules that must be complied with at all times, and guideline sections describing good engineering practices.

As can be seen in Fig. 1, there are two forms of procedures: general procedures not related to specific projects and project-oriented procedures.

General procedures are established to cover the majority of the projects undertaken.

A project-oriented procedure will only be established if no general procedure fits the project.

In case a client has specific requirements, the project-oriented procedures shall fulfil both the quality assurance manual and the client's requirements.

All general procedures are registered in a database, and employees are able to call this register on-line to see which procedures are available.

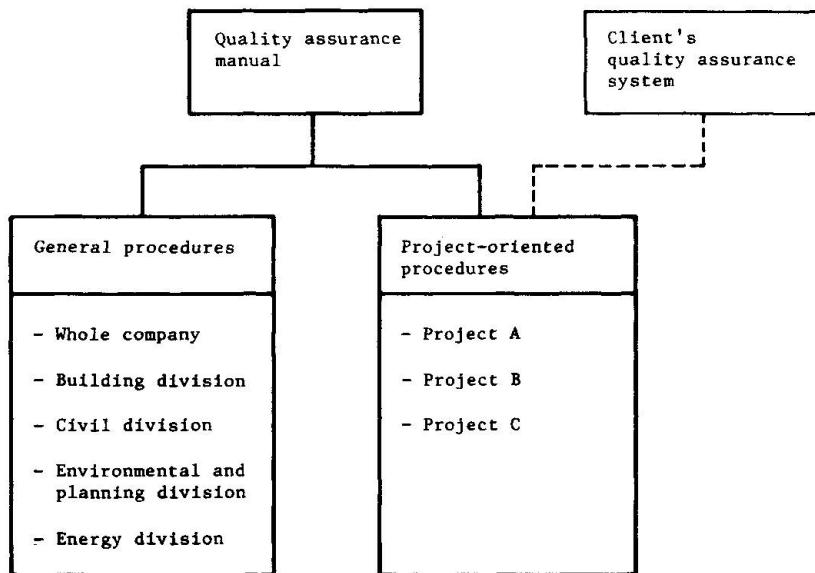


Fig. 1 Quality Assurance System

## 6. SELECTED ELEMENTS

Three of the parameters identified to contribute to the quality of the projects are described in detail.

### 6.1 Organization

The organizational structure of the company can be viewed in two ways: it can either focus on the project organization, which solves actual tasks, or focus on the basic organization, which supplies the engineering and administrative resources to the project organization.

#### 6.1.1 Basic Organization

The basic organization is structured in four individual divisions with a common management and common technical and administrative functions.

For the whole company, a Technical Director is appointed and a Chief Engineer, Quality Assurance, reporting to the Technical Director. In each division, Assistant Technical Directors are appointed to cover the disciplines undertaken, and a Quality Assurance Engineer.

These functions are established to ensure that a high technical standard is developed and maintained, and that the quality policy is attained. Lines of information and coordination between the Assistant Technical Directors and the Technical Director are established independently of the administrative reporting lines.

#### 6.2.2 Project Organizations

For each project, a project organization is established with a clear definition of tasks and responsibilities, as well as effective internal and external communication lines.

A project organization is, in principle, shown in Fig. 2.



Head of departments are responsible for the technical standard and the project manager for the execution of the project. Head of departments have the authority to delay a project until the technical standard is sufficient. This separation of responsibility is considered important, as the project manager will be challenged by qualified opponents in each project, and an adequate balance between the technical aspects and the project management is obtained.

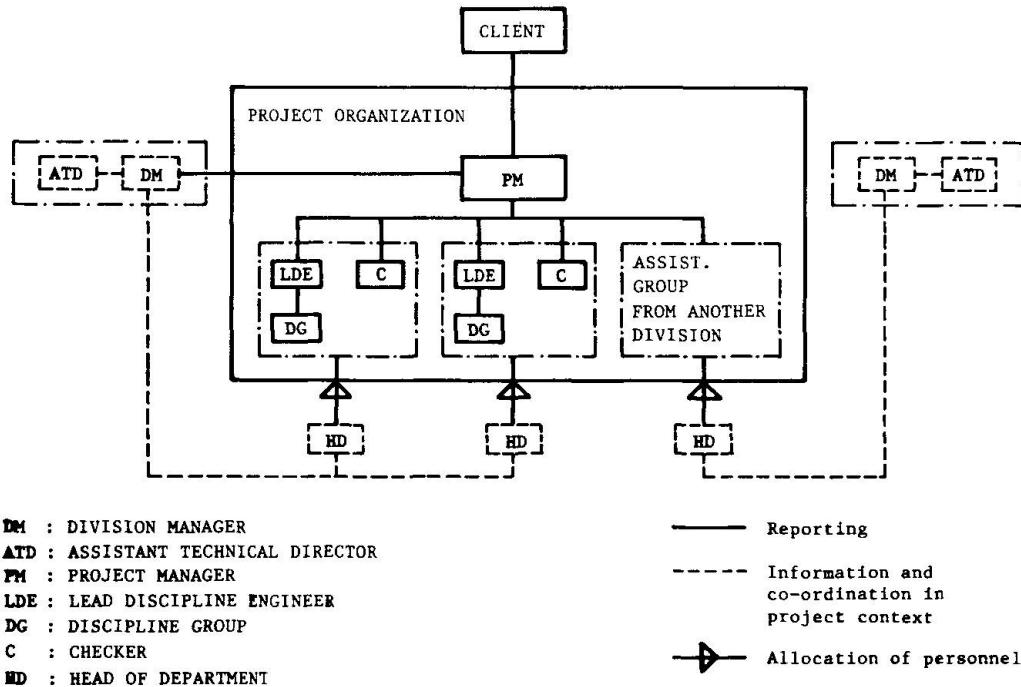


Fig. 2 Project Organization, in principle

### 6.2 Document Control

A consulting engineer produces documents (drawings, conditions, specifications, reports, etc.), and it is of the utmost importance to have an effective document control system to ensure that documents are issued for the purpose intended by authorized personnel, and that the documents are available at the right places at the right time.

All documents are provided with a document title, a job number, a serial number, an issue number, a date, and signatures for preparation, checking, and approval. Revised documents are given a new issue number and provided with signatures for preparation, checking, and approval of the revised document. Index lists are maintained showing the issue number of all documents prepared. Distribution lists are prepared for each document or each type of document, both for internal and external distribution.

The meaning of each signature in a document is defined.

For instance, signing for approval shall be done by the lead discipline engineer in charge. The signature means that the document has been prepared by a qualified person, that the document has been checked by a person not involved in the preparation of the document, and that the document is released to be used outside the discipline group.

### 6.3 Audits

To identify and control the parameters influencing the quality is a complex task and the effectiveness of the system should be constantly evaluated, and if necessary, adjusted. Furthermore, it should be verified that the intentions laid down in the quality assurance manual are implemented.

Audits are an effective tool for this purpose.

Two kinds of audits are performed:

- System audits
- Product audits.

System audits are performed with the purpose of:

- Verifying that applicable procedures are adhered to
- Evaluating the effectiveness of the procedures
- Identifying areas where improvement is needed.

Product audits are performed with the purpose of evaluating management and the technical standard of a specific project.

Audits performed are reported to the division management and to the person responsible for the area audited for corrective action if any deficiencies are identified.

The audit function is in the process of being implemented, but it may in certain cases be met with resistance and is generally considered as one more bureaucratic obstacle.

If audits are performed in a constructive atmosphere, highlighting topics essential for project success, it is our experience that audits will be considered as an effective management tool by project managers and head of departments.

## **7. FINAL REMARKS**

The aim has been to establish a flexible system which defines "what to do" and not "how to do it" and "to what extent". These decisions will remain with the project responsible. However, it is ensured that these decisions will be taken at the right time during the project execution.

The authors are well aware of the difficulties by implementing the quality assurance system described. However, it is believed that this concept on a long term basis will contribute to maintain and improve the quality of the services rendered in a cost effective way. To reach this target it is a condition that the system is considered by the employees as an effective tool in the daily work and not as one more bureaucratic exercise. To obtain this is a real challenge.

It the authors' hope that other colleagues, who are in a similar situation, can find some help and inspiration in this paper.

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