DEVELOPING AND MAINTAINING AN ISO 9001 QUALITY SYSTEM IN A MULTIDISCIPLINARY ENGINEERING CONSULTANCY

1 INTRODUCTION

This Practice Note has been adapted from a paper presented to the 1996 Annual Conference of the Institution of Professional Engineers by Trevor Anders and Ian Fraser, Beca Carter Hollings and Ferner Ltd (BCHF), a long-standing ACENZ Member. Although the example illustrated in this discussion is based on a large, multidisciplinary firm, with a number of offices throughout the country, and the quality system has been extrapolated to BCHF's subsidiary companies, there are many points contained in this paper that would be applicable to implementing a quality system in any size firm.

Notes have been provided at the end of this Practice Note on how members might apply the principles discussed here to their own, smaller practice. ACENZ has also prepared Practice Note B33 to cover such firms.

1.1 Background

This Practice Note provides an overview of the development of a quality system to a large, multidisciplinary consulting firm. It examines some of the problems encountered and the successful strategies used to effect progress.

A primary goal of a quality system should be to ensure ongoing improvement and the mechanisms for this are discussed.

Part of the strength of the ISO 9001 Standard (1) (2) is its universal applicability, but only when properly tailored to suit the corporate body to which it is applied. In this respect engineering consultancies have some specific requirements and interpretations of the Standard.

Members are also advised to refer to the International Federation of Consulting Engineers (FIDIC) ISO quality management requirements guideline which was updated in 2008. .

1.2 Description of Beca Carter Hollings and Ferner

Founded in 1918, Beca Carter Hollings and Ferner Ltd (BCHF) is the main operating company of the Beca Group. BCHF is the largest privately owned engineering consulting practice in the country employing around 1200 staff in New Zealand. The sole business of BCHF is the provision of professional engineering and related services: traditional engineering disciplines as well as areas such as town planning and resource management, quality management services and others.

The company comprises some 30 operating Sections, generally single discipline oriented, each of which is a semi-autonomous business unit with its own strategic plan and profit and loss accounting. Nevertheless BCHF operates as an amalgamation of resources which can be deployed to work on any particular project irrespective of its location. BCHF undertakes major multidisciplinary projects involving individuals or work groups from more than one office both in New Zealand and overseas. The quality procedures reflect the needs of such projects.

This geographically separated team work allows deployment of the best skills available for the job, and optimisation of resources, but is only efficient because of common systems and good communication.

2 MOTIVATION FOR IMPLEMENTING A QUALITY SYSTEM

The decision to implement a quality system based on the NZS/ISO 9001 Standard acknowledges the increasing international acceptance of the value and significance of this Standard.

In particular, the company perceived potential benefits from implementing a quality system to be:

- Improved operating efficiency
- Improved service to clients
- Improved working environment resulting in enhanced job satisfaction for all personnel
- Satisfying future market expectations for a certified quality system

3 DEVELOPMENT OF THE QUALITY SYSTEM

Following some initial evaluation and establishment work, a project manager was allocated the full time task of coordinating the development and implementation of the quality system across the company. The process was overseen by a Board Member and Company Director.

3.1 Objectives

> From the start, it was important to be clear about what the objectives were, specifically what was meant by "quality" and a "quality system". Although these are defined by the International Standards Organisation (3), it was more helpful to use definitions that are more meaningful in the context of an engineering business. The quality system was defined as "an organisational tool to help consistently achieve the established quality objectives", which is to *"cost effectively meet client requirements, while satisfying prescribed standards, thus achieving fitness for purpose and value for money."*

The phrase "fitness for purpose", is used in its fullest sense, as being synonymous with quality.

3.2 Steps Involved

The first task was to develop the documented system, including a hierarchy of documents (Figure 1) comprising:

- The *Company Quality Manual*, a policy level and broad brush descriptive document (4);
- *Quality Procedures*, which contain the definitive requirements of the quality system, identifying what must be done by whom, and when.

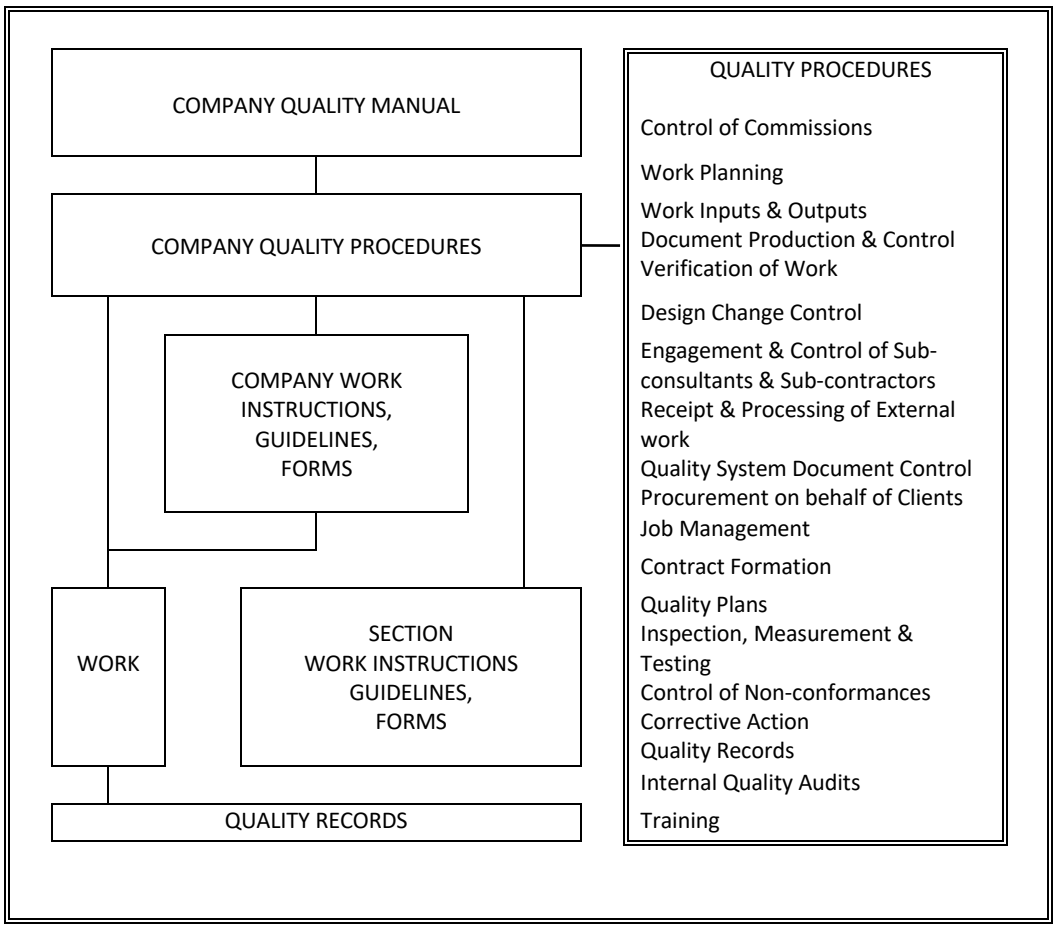

Figure 1: *Quality System Documentation*

Each procedure may additionally be supported by:

- **Work instructions**, which provide mandatory methods or the tools to implement the requirements of the procedures, and
- **Guidelines**, which assist interpretation of the procedures or provide guidance in carrying out tasks or achieving objectives.

Quality system forms may be associated with either work instructions or guidelines.

As a later development, Sections within the company began developing their own Section or discipline-specific work instructions and guidelines, supplementary but subordinate to the company procedures.

3.3 Criteria

In developing the system, the following criteria were applied:

- The procedures, while compliant with ISO 9001, had to reflect the special business environment and needs of the company, rather than automatically assume the structure of the ISO 9001 chapters;
- "Fitness for purpose" had to be reflected in the procedures;
- A "keep it simple" doctrine was employed;
- The procedures had to reflect what was currently regarded as "best practice" in the company;

- As wide an input as possible from staff across the company was to be sought, to tap into their knowledge as well to promote "ownership";
- Flexibility was to be maintained, and innovation not stifled;
- Procedures had to be applicable to *all* client work for *all* disciplines.

The nature of the predominantly engineering consultancy business required very specific interpretations of elements of the ISO 9001 Standard. For instance, addressing of clause 4.6 of ISO 9001, *Purchasing*, was chiefly reflected in the procedure titled *"Engagement and Control of Subconsultants/Subcontractors"*. Clause 4.4 of ISO 9001, *Design Control*, translated into four of the twenty-one company quality procedures.

As the "keep it simple" doctrine has been misinterpreted in the past, it has been re-phrased as "keep it simple but don't make it Mickey Mouse". This adequately covers the level of simplicity which is no longer helpful, as it leaves too many questions unanswered.

Key employees were selected to record their work methods, which were then peer reviewed. Development of all procedures was undertaken entirely in-house. The benefits of involving staff in the development phase had to be balanced against the inevitable delays this caused as client work would always take precedence over internal system demands.

A particular challenge in developing the system was to make it applicable to the very wide range of discipline, scope and size of jobs that the company carries out. This was achieved by building in flexibility, primarily by requiring that the right person will be called upon to make the right decision at the right time.

For example, within the company, each job has a Principal assigned to it as the Job Director. They take a very active role at the start of the job to ensure that the commission is properly set up, and that a quality plan, including the verification plan for the job, has been appropriately established. Thereafter, the Job Director overviews the more direct management of the job by the Job Manager.

The procedures went through various drafts: A and B were early revisions, C was sent out for wider review and revision D was distributed for mandatory compliance. By the time revision 0 (zero) was issued, the procedure for issue and review of quality system documents had itself evolved, and has since governed all subsequent issues of quality system documents.

4 IMPLEMENTATION OF THE QUALITY SYSTEM

4.1 Management Level

A quality system organisational structure (Figure 2) was created to facilitate implementation across the company. The programme enjoyed the full endorsement of the Managing Director and Board, which appointed a Board member to convene the Quality Task Force (later the Quality Management Steering Committee). This body met monthly to oversee the development and implementation of the system. The Management Quality Representative reported to the Quality Task Force Convenor, and was responsible for liaising with all others as necessary to achieve the broad objectives set. A Section Quality Representative (SQR) was appointed for each company Section, to support the Section Head in implementing the system within that Section.

4.2 Staff Level

Staff were advised of the scope of the development and the changes that lay ahead for them. A **quality awareness campaign** informed staff about the programme, the reasons for implementing an ISO 9001-based quality system, and fundamental concepts of quality. This was accomplished

by various communications, including a newsletter, and training for all staff. Workshops were held with senior management to introduce the concepts, strategy and programme.

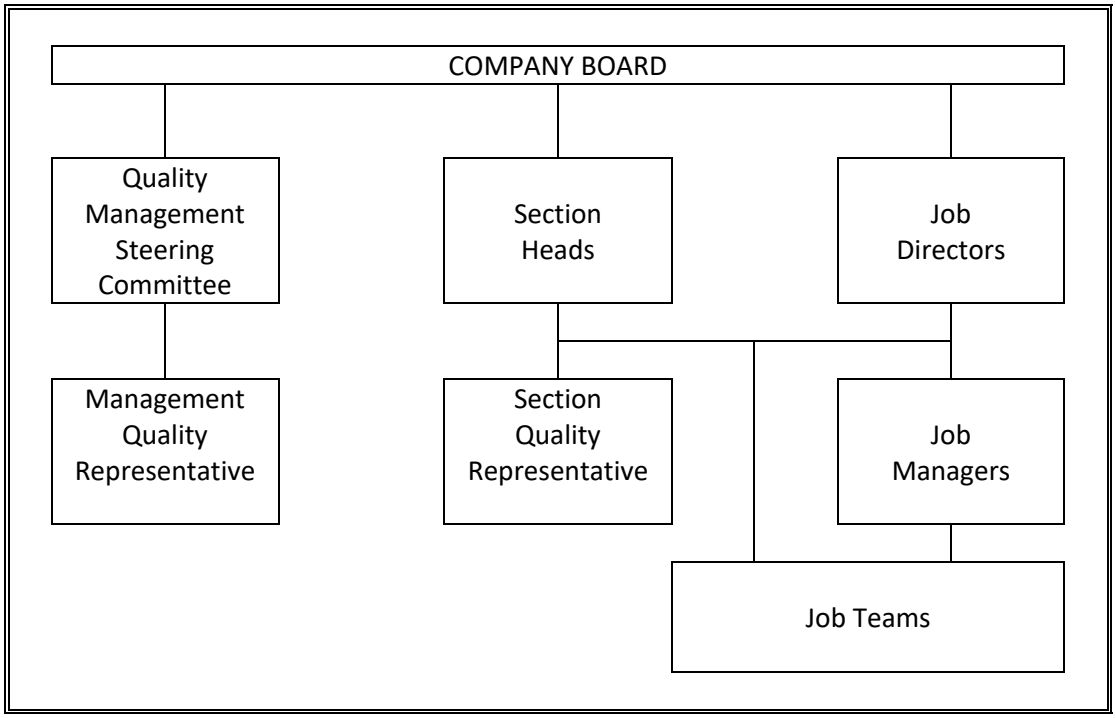

Figure 2: *Quality System Management Structure.*
Lines indicate responsibility where there is liaison among levels

4.3 Auditing the System

At a fairly early stage of development, a careful evaluation of potential certification bodies was carried out. It was important to employ a body with whom to establish a good working relationship, and who would be able to relate to this particular business. Standards New Zealand was selected and was involved in early discussions to confirm that the project was on track.

Initially it was intended to implement the system in a pilot area/section rather than across the whole company simultaneously. As it turned out, the process of achieving procedures that would be acceptable company-wide resulted in the pilot area concept being scrapped for this company, although this could be a viable approach in other circumstances.

Following quality awareness training, workshops were held to introduce the procedures to Section Quality Representatives and others. They in turn took the information back to their Sections and carried out training via lunchtime or other sessions, and on the job. Feedback from these exercises was incorporated into the next revision of the procedures, and more training took place throughout the company.

At this stage internal auditing was introduced, using the few trained internal quality auditors then present in the company. (Later a number of in-house internal quality auditors were trained, providing an invaluable resource). The internal audits were initially more training exercises than audits, and have retained this valuable role, though they have progressed to a stage that they are now very effective at measuring compliance as well. Audit checklists were developed, and made available to Sections, many of which then used them to conduct their own “informal” audits.

Formal Certification audits were carried out by Standards New Zealand between November 1993 and January 1994. Quality Assured Supplier status was awarded in April 1994.

5 ONGOING IMPROVEMENT

It is sometimes incorrectly stated that an ISO 9001 based quality system, may simply entrench bad practice, and not promote improvement. This is quite untrue, of course, as in the process of implementing the system, existing company practice can be critically appraised and improved where found to be deficient. Then there are improvement mechanisms inherent in the system itself, all of which are useful, as follows.

5.1 Systematic Review of Procedures

Once a procedure is formalised within the quality system, its distribution and currency are maintained as prescribed, and all that can happen to it is ongoing enhancement, or adjustment to reflect changing needs.

For example, submissions for change may be made by anyone in the company. They are recorded and filed against the particular document(s) to which they relate, and at the time for review of the document (which may be triggered by routine programmes or special needs) they are all considered by the review team.

Since certification a number of procedures have been upgraded. A series of safety-related work instructions have been included that reflect the integration of the company's health and safety system with the quality system. ISO 9001 was itself revised for the first time in 1994, and changes in the Standard have needed to be reflected in the company procedures.

5.2 External Audits

After the initial certification audit, external audits have been carried out on a six monthly basis. These are very useful in terms of providing an external perspective, and motivation to keep the company on its toes. Increasingly internal audits, which are far more frequent and extensive, are useful to promote ongoing improvement.

5.3 Internal Audits

The internal audit programme is one of the most effective means of:

- Training Sections and staff in the correct interpretation of quality system requirements;
- Gaining consistency of practice across the company;
- Establishing levels of compliance in specific areas as well as generally in the company;
- Identifying problems and opportunities for follow up.

A team of around twelve part time internal auditors has been trained internally. Each auditor conducts several audits annually as a Lead Auditor (as well as some in a support role) in order to maintain their status as authorised Company Lead Auditors. In-house training is essential, irrespective of the external experience or qualifications of the auditor. The special nature of the engineering consultancy business reflects the fact that the main audit unit (ie a given job) is always potentially unique, and a large level of discretion may reside with the Job Director, Job

Manager and team. Hence there is a requirement for careful and skilled evaluation and interpretation by the auditor.

Normally those being audited are a Section. They are audited first in terms of compliance with general quality system requirements, after which a number of jobs are selected for audit to provide a satisfactory sample in terms of the audit plan.

5.4 Corrective Action Requests

"CARs" are normally issued during internal audits, and have a special status in that case. A CAR can nevertheless be issued by anyone for any legitimate reason. A formal process then ensues, with investigation and action appropriate to the nature of the problem identified. Also CARs are used to register customer complaints or concerns, to ensure appropriate follow up.

5.5 Management Review Meetings

ISO 9001 requires that the company's management holds a review of the quality system at defined intervals to ensure its continuing suitability. An annual management review meeting, includes collated audit findings, submissions for changes to procedures, survey results, and feedback and recommendations from Sections and Divisions. The meeting addresses the questions: "Does the quality system meet our needs - does it serve us well?"

Recommendations for changes, if any, are made at the meeting, and forwarded to the Board for endorsement and implementation via the Quality Management Steering Committee.

6 GOOD IDEAS AND HAZARDS

A few hazards to avoid, along with a summary of key benefits that have been identified and useful approaches are given in Figure 3.

BENEFITS		POINTERS	
Originally Perceived	Experienced	Good Strategies	Potential Hazards
• Improved efficiency	• Better communication verification less rework • More cost effective operation	• Strong internal audit programme • Additional informal audits & job team reviews	• Underestimating the scale of activity & level of commitment needed
• Improved customer service	• Better ongoing definition of services	• Measuring & reporting progress on implementation	• Reliance on inputs from those who will not deliver
• Enhanced working environment	• Better communication • Improved procedural tools, communication & training resources	• Demonstrable man-agement commitment • Company & section annual management reviews	• Under-resourcing • Inadequate or over-optimistic planning
• Market access	• Generally supports customer confidence		

Figure 3: *Key Benefits and Pointers in the Implementation of a Quality System:*

6.1 Internal Auditing

A strong emphasis on internal audits, especially using the coaching approach, helped orientate

Sections as to what was required and provided an additional incentive to achieve compliance. Sections also used the checklists developed to carry out their own informal auditing, as part of their training program and preparation for the formal internal audits. A more recent and very useful approach involves job team reviews, at which a completed job is closely analysed by members of the job team and others for compliance with quality and technical requirements. Team members find this more interactive, more interesting and a better learning experience than formal audits or training sessions.

6.2 Measurement and Motivation

Ways to measure participation and progress were sought during the implementation phase. One of these included defining a separate cost code (job phase number) to identify quality training and development work done in Sections. **"Quality hours"** recorded against this were reported at management meetings of Section Heads. This helped to focus attention on effort needed to make progress.

Once the system was established a **Quality Performance Index** was developed for Sections, which reflects their performance in internal quality audits and their response in closing out CARs issued at those audits. This provides a reasonably representative basis for comparing Section performance, and adds a healthy competitive flavour to the quality programme.

6.3 Commitment and Effort

All quality authorities make the point that management commitment, particularly top management commitment, is vital. This can never be overstated, and there can never be too much commitment. Some Section managers, even though already very busy, led the training and implementation roles themselves, rather than delegate to newly appointed quality representatives. Those Sections were generally the ones which first experienced the benefits of the quality system.

6.4 Section Management Reviews

The practice of carrying out a quality system management review has now been established at a Section level. Reviews cover a wide area of management, but focus particularly on quality system performance. Outputs from the Section management reviews provided inputs to last year's company review.

7 COSTS AND BENEFITS

The more comprehensively one applies quality practice, the more indivisible it becomes from one's normal work. Thus it is hard to separate and quantify costs and savings.

7.1 Costs

The cost of developing and implementing the programme was primarily the cost of one full time project manager for a period of two to three years, with secretarial support, plus the time of other staff equivalent to between one and two people full time, and overheads of travel and printing of a few thousand dollars per annum. The formal training hours per staff member work out to be fairly minimal, and much of that relates to reinforcing current best practice, and indicating where help can be obtained via the procedures.

For a large company the direct certification costs (payable to the certification body for registration and hourly rates) are relatively small. In this case these costs amounted to around $30,000, with an ongoing post-certification cost of approximately $10,000 per annum.

7.2 Benefits

Benefits are hard to evaluate in dollar terms. Comparisons of before and after scenarios are distorted or completely eclipsed by a variety of other factors. For instance, implementation of this quality system was begun in a depressed economic climate, where breaking even was a challenge. In a much more favourable climate, company performance is good and continues to improve. Although the quality programme is likely to be a contributing factor, it is not easy to quantify.

A **quality costing system** (or, more accurately, the cost of non-optimal performance) can be implemented. This can only be really useful for a company which already has a mature quality system. Once in place, this should help more accurately quantify potential and actual savings, and add motivation.

At an early stage, benefits are best evaluated qualitatively. A majority of senior staff are seeing clear benefits arising in:

- procedures for commissioning work, resulting in better communication with clients and less liability exposure
- a greater level of consistency of approach across the company, resulting in smoother integration of work for jobs being carried out by more than one Section or office
- better briefing between and within Sections, resulting in more cost effective achievement of objectives
- less rework, arising from better communication and procedural tools.

Particularly for new and less experienced staff, the quality system has provided a framework for learning good practice and having confidence in what they are doing.

8 THE WAY AHEAD

This example illustrates a company positioned relatively close to the start line of the long road that is often referred to as the “quality journey”. There is still much to do that will be beneficial. The small quality system office team has recently been increased to include three full time staff, including secretarial support. The philosophy remains to have a company wide system, but with local Section flavour; to have initiation and co-ordination of quality projects at a company level, but to have hands on ownership at a Section level.

The following projects are on the drawing board:

- expanding the scope of the quality system to include Section management and internal services (such as Accounts and Human Resources)
- further developing technical guidelines and standards to better communicate the wealth of expertise in the company
- introducing a quality costing system and using other key management indicators
- continuing training to advance a culture of quality in the company
- specific improvement initiatives over and above those normally ensuing from the quality system
- continuing to enhance auditing methodology, including job team reviews.

9 CONCLUSION

9.1 Summary of Implementation Success

Implementation of a quality system across a large and diverse engineering consultancy has been conservatively carried out. Progress has been slow but sure, with the whole organisation, in its component parts, moving fairly much together along the development road. Sometimes progress has seemed too slow, or disappointing, but at the third annual management review of the quality system in September 1995, when reviewing progress over the two previous years, it was evident that considerable advances had been made.

Whereas there was initially some level of scepticism amongst a good percentage of staff, there is now nearly universal acceptance of the value of the quality system, with a number of real enthusiasts. One manager of a small individualistic Section initially felt that the quality system had imposed a sense of guilt on him, and wistfully stated he would really advocate a one page quality system. Recently he found that his Section had emerged as the top performer in the latest round of internal quality audits.

Now, with some of the hard work done, and the basis and merits of the system generally understood throughout the company, the company is well positioned to accelerate progress in a broader range of quality management initiatives.

9.2 Extrapolation to Medium and Small Firms

Medium and small sized firms embarking on the introduction of a quality management system should not find the above paper daunting but rather should note that it is considerably more difficult for a multidisciplined, multi-office, international firm such as this to introduce a Quality Management System than it is for the majority of ACENZ Members.

It is possible for a single office to produce a manual, implement procedures and begin internal auditing within six to twelve months, provided the Principals or senior managers are committed and the project is led from the front. Indeed it is in ACENZ's Policy that all members undertake this minimum commitment to Quality (refer PN B31).

While Certification by an external auditing body such as Standards NZ is not mandatory, it does provide a useful goal and milestone and prevents the quality journey from becoming stalled or sidelined.

9.2 Costs involved for Small and Medium Firms

The cost of Certification depends on the size, complexity and location of offices. There are at least nine Accredited Certification bodies currently operating in New Zealand. A firm of, say, three partners and ten staff in a single discipline office, a common set up among Members, should budget for under $10,000 in the first year and $2000 - $3000 in subsequent years.

At least one person in a firm should undergo some internal quality auditing training. A number of courses and seminars are available throughout the country.

The opportunity cost of Principals and staff time spent meeting, writing policy and procedures and compiling the documents will vary and is for individual firms to assess. A good starting point might be to attempt to quantify the time cost in a given period for non-chargeable re-work, scope changes not covered by a fee agreement, disputes and Professional Indemnity notifications, and fees disputes and debtor recovery. This unproductive time is the amount that could be better spent working on a Quality Management System.

9.3 Information on Quality Systems

[Added June 2001]

Notes on where to start with a quality programme are available in Practice Note B33, prepared in 1999. The ACENZ Policy Statement on Quality is contained in Practice Note B31.

ISO 9000 was revised and restructured in 2000. FIDIC is preparing a new version of its Guideline to ISO 9000 and ACENZ is likely to prepare a new Practice Note following the release of the FIDIC document.

Various training courses and documents on ISO 9001 are available through Standards NZ and Members are recommended to contact this source in the first instance.

9.4 Conclusion

The authors to this Practice Note conclude that implementing a quality system has been a positive experience and the rewards are on-going. They trust that others embarking on a similar path will find their words inspiring and relevant.

ACKNOWLEDGEMENTS

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REFERENCES

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2	ISO 9004-2:1991	Quality management and quality system elements Part 2: guidelines for services
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4	AS/NZS 3913:1992	Quality manuals - Guide to preparation