

ISO 9000 SERIES: A VALUE ENGINEERING OPPORTUNITY

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ABSTRACT

This paper examines the ISO 9000 Series of quality system standards and guidelines which were adopted as American National Standards Q90, Q91, Q92, Q93 and Q94 in 1987. Examination includes the background, intent, content and application of these generic comprehensive standards. Implications for Value Engineering (VE) applications are identified even though standards do not explicitly identify or require any specific methodologies. Knowledge of these standards will allow value engineering practitioners to provide valuable support to the growing number of organizations, market sectors and industries implementing these standards.

VE has failed to become widely and commonly applied as there are few tangible drivers to institutionalize the methodology. While sophisticated customers and globally competitive suppliers embrace value engineering (VE), they are not sufficiently common in all industries and business sectors. This condition may change as the ISO 9000 - ANSI/ASQC Q90 Series of quality system guides and standards are more widely implemented. Sufficient implication of VE activities exists within this set of standards to provide the necessary incentives or empowerment for common value engineering application. Before claiming this license; the VE community must first understand the background, intent, content and implementation aspects of the series. Additionally, VE practitioners must be aware of specific references within the series with VE implications to claim their license.

BACKGROUND OF ISO 9000-4

Over a decade ago, the international General Agreement on Tariffs and Trade commission recognized the restriction on open or "free" global trade created by technical requirements such as multiple national and regional quality standards. To reduce these economic barriers, the International Standards Organization through input and concurrence of member countries developed the ISO 9000 Series of standards for quality systems in 1987. The intent was to provide a uniform set of quality standards and allow countries to enforce or require conformance to these ISO standards without being guilty of restraint of trade. The American National Standards Institute (ANSI) is the United States representative to ISO. British Standard 5750 served as the initial model for ISO 9000 Series (See Figure A for historic precedents). This model was considerably revised from its original form to attain approval by the ISO members. To provide flexibility necessary for global application to all products and services within varying social, political, financial, ecological and technical environments; the standards typically describe "what" must be accomplished rather than prescribing specific methods, techniques or technology for accomplishment. Levels of performance are left to the determination of the organization and its customers unless otherwise controlled by product, safety or environmental statutory regulations. Since the ISO 9000 Series standards frequently refer to satisfaction of customer or other (statutory, etc.) requirements and expectations, they are at least as demanding as the customer and are complementary to customer and statutory requirements; not an alternative. Because they identify basic minimal requirements, they may be more demanding than some customers who don't specifically state

requirements; e.g. private retail customers. Additionally, the standards are voluntarily accepted and implemented at the regional (EC, ASEAN, ARSO, etc.), national and customer levels. The ISO 9000 Series was adopted without technical changes as American National Standards Q90 Series, 1987. Applying a unique identification to the ISO Series when they are adopted as national standards is common practice. A cross reference of the various national titles was published by the Institute for Quality Assurance (UK) and is reproduced in Figure B. For brevity, future text comments will reference only the appropriate Q90 Series document even though the comments apply equally to the corresponding ISO 9000 Series or equivalent national standard document. The Q90 series numbering system removes two zeroes from the ISO 9000 series document; e.g. Q92 = ISO 9002.



Figure A

THE ANSI/ASQC Q90 SERIES

The ANSI/ASQC Q90 Series is comprised of five separate but related documents, each serving a specific purpose. Two of the documents are guidelines and three are separate, independent standards. The documents are:

ANSI/ASQC Q90 "Quality Management and Quality Assurance Standards - Guidelines for Selection and Use" is a guideline as stated and is not a standard by itself. Its purpose is to provide an overview of the series and guidance in selecting the most appropriate standard from Q91, Q92 or Q93. It also provides insight in applying elements of the Q94 quality system elements guideline. Since Q90 provides an overview, it should be well understood before proceeding to the actual standards.

ANSI/ASQC Q91 "Quality Systems - Model for Quality Assurance in Design / Development, Production, Installation, and Servicing" applies to most of the product life cycle from concept to customer service or the "quality spiral" as it is referred to in the series. This is the most demanding and comprehensive of the three standards. Q91 is also the only standard specifically identifying requirements for design / development engineering or servicing after sales. Most sites currently adopting Q90 Series models are utilizing this level when it is appropriate for their activities. Although this model has the most opportunity for VE implications due to its status as a standard and engineering focus, Q92 also offers entries or links for VE as do guidelines Q90 and Q94.

ANSI/ASQC Q92 "Quality Systems - Model for Quality Assurance in Production and Installation" applies to sites not providing a design engineering function, service after installation or not desiring to include these activities in their quality system. This model was the most popular when the Q90 Series was introduced in 1987, but now only constitutes about one-third of new applications.

National Quality Standards Cross Reference

Table from 3/90 Quality News, IQA - Printed in 6/90 Quality Progress

Standards body	Quality management & quality assurance standards:	Quality systems: model for quality assurance in	Quality system: model for quality assurance in	Quality systems: model for quality assurance in

	guidelines for selection & use	design/development, production, installation & servicing	production & installation	final inspection & test
ISO	ISO 9000: 1987	ISO 9001: 1987	ISO 9002: 1987	ISO 9003: 1987
AUSTRALIA	AS 3900	AS 3901	AS 3902	AS 3903
AUSTRIA	OE NORM-PREN 29000	OE NORM-PREN 29001	OE NORM-PREN 29002	OE NORM-PREN 29003
BELGIUM	NBN X 50-002-1	NBN X 50-003	NBN X 50-004	NBN X 50-005
CANADA	---	---	---	---
CHINA	GB/T 10300.1-88	GB/T 10300.2-88	GB/T 10300.3-88	GB/T 10200.4-88
DENMARK	DS/EN 29000	DS/EN 29001	DS/EN 29002	DS/EN 29003
EUROPEAN COMMUNITY	EN 29000-1987	EN 29001-1987	EN 29002-1987	EN 29003-1987
FINLAND	SFS-ISO 9000	SFS-ISO 9001	SFS-ISO 9002	SFS-ISO 9003
FRANCE	NF X 50-121	NF X 50-131	NF X 50-132	NF X 50-133
HUNGARY	MI 18990-1988	MI 18991-1988	MI 18992-1988	MI 18993-1988
INDIA	IS: 10201 Part 2	IS: 10201 Part 4	IS: 10201 Part 5	IS: 10201 Part 6
IRELAND	IS 300 Part 0/ISO 9000	IS 300 Part 1/ISO 9001	IS 300 Part 2/ISO 9002	IS 300 Part 3/ISO 9003
ITALY	UNI/EN 29000-1987	UNI/EN 29001-1987	UNI/EN 29002-1987	UNI/EN 29003-1987
MALAYSIA	---	MS 985/ISO 9001-1987	MS 985/ISO 9002-1987	MS 985/ISO 9003-1987
NETHERLANDS	NEN-ISO 9000	NEN-ISO 9001	NEN-ISO 9002	NEN-ISO 9003
NEW ZEALAND	NZS 5600: Part 1-1987	NZS 5601-1987	NZS 5602-1987	NZS 5603-1987
NORWAY	NS-EN 29000: 1988	NS-EN 29001: 1988	NS-ISO 9002	NS-ISO 9003
SOUTH AFRICA	SABS 0157: Part 0	SABS 0157: Part I	SABS 0157: Part II	SABS 0157: Part III
SPAIN	UNE 66 900	UNE 66 901	UNE 66 902	UNE 66 903
SWEDEN	SS-ISO 9000: 1988	SS-ISO 9001-1988	SS-ISO 9002: 1988	SS-ISO 9003-1988
SWITZERLAND	SN-ISO 9000	SN-ISO 9001	SN-ISO 9002	SN-ISO 9003
TUNISIA	NT 110.18-1987	NT 110.19-1987	NT 110.20-1987	NT 110.21-1987
UNITED KINGDOM	BS 5750: 1987: Part 0: Section 0.1 ISO 9000/EN 29000	BS 5750: 1987: Part 1: ISO 9001/EN 29001	BS 5750: 1987: Part 2: ISO 9002/EN 29002	BS 5750: 1987: Part 3: ISO 9003/EN 29003
USA	ANSI/ASQC Q90-1987	ANSI/ASQC Q91-1987	ANSI/ASQC Q92-1987	ANSI/ASQC Q93-1987
USSR	---	40.9001-88	40.9002-88	---
WEST GERMANY	DIN ISO 9000	DIN ISO 9001	DIN ISO 9002	DIN ISO 9003
YUGOSLAVIA	JUS A.K. 1.010	JUS A.K. 1.012	JUS A.K. 1.013	JUS A.K. 1.014

Figure B

ANSI/ASQC Q93 "Quality Systems - Model for Quality Assurance in Final Inspection and Test" is the most limited and least used model. It is estimated that less than 5% of new Q90 Series systems use this model. In many ways, it is similar to Military Standard 45208.

ANSI/ASQC Q94 "Quality Management and Quality System Elements - Guidelines" provides insight of the expected structure of a quality system and the various elements which might be included. It is recommended that this document be reviewed after Q90 to further develop an understanding of both quality systems and the

series before a model selection from Q91, Q92 or Q93 is made. VE practitioners should become very familiar with this guideline due to its wealth of references to business, economic and performance issues which can be addressed by VE related activities.

Perhaps the most convenient method of quickly appreciating the content of the standards and differences between them is the Figure C comparison matrix based on the Q90 annex. The matrix compares elements of a quality system noted primarily in Q94 with the requirements for that element found in the three model standards -Q91, Q92 and Q93. The first two columns of the matrix provide the Q94 reference paragraph and quality system element name. You will note the last element "Purchaser Supplied Product" which refers to Purchaser (Customer) raw material, components, etc. undergoing contracted work or modification (heat treat, assembly, direct mailing or shipment, repair, etc.) does not have a reference paragraph in Q94. However, requirements for this element are found in the current Q91 and Q92. Some elements of Q94 (Economics <Quality Costs> and Product Safety / Liability) do not have stated requirements in the current Q91, Q92 or Q93. As you can see from the matrix, Q91 is the most comprehensive and demanding

of the standards.

USE OF STANDARDS / REGISTRATION

While some organizations use the standards simply as models or benchmarks for establishing their quality systems, many continue their efforts and investment by pursuing registration for their quality system to ensure market access, satisfy increasing specific customer requirements, maintain competitiveness or provide a frame for Total Quality Management. Registration is the formal and legal acknowledgement of conformance to an identified standard (Q91, Q92, Q93 -not Q90 or ISO 9000) at a specific site for certain products, services or processes by an authorized and recognized Registration Organization or Registrar. Registrars or Registration Organizations are identified and authorized by recognized accreditation bodies in ISO member countries to perform registrations within that country. Through reciprocity agreements, Registrars operate in many countries besides their homeland.

System registration is classified according to site / product / service / process. A site can vary from a complex of adjacent buildings performing related activities for a single product or service, to a single building, or to a single production line within a building. Site definition is determined during negotiations with the Registrar. After the site and desired scope of system registration is determined, the typical registration sequence includes:

- * Application to the desired Registrar
- * Submission of quality manual to Registrar for evaluation
- * Evaluation of quality manual by Registrar
- * Corrective action taken on the Registrar's critique of manual
- * Preassessment visit by Registrar (Optional, but typical)
- * Onsite assessment by Registrar
- * Corrective action and reassessment as necessary

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- * Full or conditional registration granted to applicant
- * Publication of registration status
- * Surveillance visits, usually twice a year by the Registrar
- * Full reassessment by Registrar, usually every three years or when appropriate due to change in site, products, processes or performance

model or outline of their actions which is producing successful site registrations. We have modified and expanded this outline to be useful within most organization structures and to be applicable to most products and services. The modified model of activities is displayed by Figure D.

In addition to the above noted sequence, DuPont has shared a Figure C

Q90 - 1987 Annex
Cross-Reference List of Quality System Elements
(This annex is given for information and does not form an integral part of the standard.)

Paragraph (or subsection) No. in Q94	Title	Corresponding Paragraph (or subsection) Nos. in		
		Q91	Q92	Q93
4	Management Responsibility	4.1 ^f	4.1 ^{l1}	4.1 ^{l2}
5	Quality System Principles	4.2 ^f	4.2 ^f	4.2 ^{l1}
5.4	Auditing The Quality System (Internal)	4.17 ^f	4.16 ⁻	---
6	Economics - Quality Related Cost Considerations	---	---	---
7	Quality In Marketing (Contract Review)	4.3 ^f	4.3 ^f	---
8	Quality In Specification and Design (Design Control)	4.4 ^f	---	---
9	Quality In Procurement (Purchasing)	4.6 ^f	4.5 ^f	---
10	Quality In Production (Process Control)	4.9 ^f	4.8 ^f	---
11	Control Of Production	4.9 ^f	4.8 ^f	---
11.2	Material Control and Traceability (Product Identification and Traceability)	4.8 ^f	4.7 ^f	4.4 ^{l1}
11.7	Control of Verification Status (Inspection and Test Status)	4.12 ^f	4.11 ^f	4.7 ^{l1}
12	Product Verification (Inspection and Testing)	4.10 ^f	4.9 ^f	4.5 ^{l1}
13	Control of Measuring and Test Equipment (Inspection, Measuring, and Test Equipment)	4.11 ^f	4.10 ^f	4.6 ^{l1}
14	Nonconformity (Control of Nonconforming Product)	4.13 ^f	4.12 ^f	4.8 ^{l1}
15	Corrective Action	4.14 ^f	4.13 ^f	---
16	Handling and Post Production Functions (Handling, Storage, Packaging, and Delivery)	4.15 ^f	4.14 ^f	4.9 ^{l1}
16.2	After-sales Servicing	4.19 ^f	---	---
17	Quality Documentation and Records (Document Control)	4.5 ^f	4.4 ^f	4.3 ^{l1}
17.3	Quality Records	4.16 ^f	4.15 ^f	4.10 ^{l1}
18	Personnel (Training)	4.18 ^f	4.17 ^{l1}	4.11 ^{l2}
19	Product Safety and Liability	---	---	---
20	Use of Statistical Methods (Statistical Techniques)	4.20 ^f	4.18 ^f	4.12 ^{l1}
---	Purchaser Supplied Product	4.7 ^f	4.6 ^f	---

Key:

f — Full Requirement

l1 — Less stringent than ANSI/ASQC Q91

l2 — Less stringent than ANSI/ASQC Q92

--- — Element not present

NOTES:

1. The paragraph (or subsection) titles quoted in the table above have been taken from Q94; the titles given in parentheses have been taken from the corresponding paragraphs and subsections in Q91, Q92 and Q93.
2. Attention is drawn to the fact that the quality system element requirements in Q91, Q92 and Q93 are in many cases, but not in every case, identical.

TWELVE STEPS TO REGISTRATION

12 REGISTRATION

11 ASSESSMENT VISIT

- 10 SUBMIT MANUAL FOR APPROVAL
- 9 MEET WITH ASSESSMENT BODY
- 8 COMPILE QUALITY MANUAL
- 7 DEFINE & IMPLEMENT NEW PROCEDURES
- 6 ESTABLISH PROGRAM
- 5 IDENTIFY WHAT NEEDS TO BE DONE
- 4 REVIEW EXISTING PROCEDURES VS. APPROPRIATE ISO 9001-3
- 3 REVIEW ISO 9004 TO UNDERSTAND QUALITY SYSTEM ELEMENTS
- 2 REVIEW ISO 9000 TO DETERMINE APPROPRIATE LEVEL (9001, 2 or 3)
- 1 SET UP A STEERING GROUP

Arch Associates Expansion of DuPont Model

Figure D

Q90.5.0 CHARACTERISTICS OF QUALITY SYSTEM SITUATIONS

In both these situations (contractual and noncontractual) the supplier's organization wants to install and maintain a quality system that will strengthen its own competitiveness and achieve the needed product quality in a cost-effective way.

Q91.4.2 Quality System: Note:

In meeting specified requirements, timely consideration needs to be given to the following activities:

- f) the compatibility of the design, the production process, installation, inspection and test procedures, and the applicable documentation;

Q91.4.3 Contract Review

The supplier shall establish and maintain procedures for contract review and for the coordination of these activities. Each contract shall be reviewed by the supplier to ensure that:

- a) the requirements are adequately defined and documented;
- b) any requirements differing from those in the tender are resolved;
- c) the supplier has the capability to meet contractual requirements.

Q91.4.14 Corrective Action

The supplier shall establish, document, and maintain procedures for:

- b) analyzing all processes, work operations, concessions, quality records, service reports, and customer complaints to detect and eliminate potential causes of nonconforming product;
- c) initiating preventive actions to deal with problems to a level corresponding to the risks encountered;
- d) applying controls to ensure that corrective actions are taken and that they are effective;

Q92.4.2 Note f same as Q91.4.2 except design is deleted.

Q92.4.3 Same as Q91.4.3

Q94.0.1 General

A primary concern of any company or organization must be the quality of its products and services. To be successful, a company must offer products or services that:

- a) meet a well-defined need, use, or purpose;
- b) satisfy customers' expectations;
- e) are made available at competitive prices;
- f) are provided at a cost which will yield a profit.

Q94.0.2 Organizational Costs

To achieve maximum effectiveness and to satisfy customer expectations, it is essential that the quality management system be appropriate to the type of activity and to the product or service being offered.

Q94.0.3 Meeting Company/Customer Needs

A quality management system has two interrelated aspects:

a) The company's needs and interests

-For the company, there is a business need to attain and to maintain the desired quality at an optimum cost; the fulfillment of this quality aspect is related to the planned and efficient utilization of the technological, human, and material resources available to the company.

Q94.0.4.1 General

Risk, cost, and benefit considerations have great importance for both company and customer. These considerations are inherent aspects of most products and services.

Q94.0.4.3.1 (Cost Considerations) For the Company

Consideration has to be given to costs due to marketing and design deficiencies, including unsatisfactory materials, rework, repair, replacement, reprocessing, loss of production, warranties, and field repair.

Q94.0.4.3.2 (Cost Considerations) For the Customer

Consideration has to be given to safety, acquisition cost, operating, maintenance, downtime and repair costs, and possible disposal costs.

Q94.0.4.4.1 (Benefit Considerations) For the Company

Consideration has to be given to increased profitability and market share.

Q94.0.4.4.2 (Benefit Considerations) For the Customer

Consideration has to be given to reduced costs, improved fitness for use, increased satisfaction, and growth in confidence.

Q94.0.4.5 Conclusion

An effective quality management system should be designed to satisfy customer needs and expectations while serving to protect the company's interests. A well-structured quality system is a valuable management resource in the optimization and control of quality in relation to risk, cost, and benefit considerations.

Q94.4.3.1 Quality Objectives

For the corporate quality policy, management should define objectives pertaining to key elements of quality, such as fitness for use, performance, safety, and reliability.

Q94.4.3.2 Quality Objectives

The calculation and evaluation of costs associated with all quality elements and objectives should always be an important consideration, with the objective of minimizing quality losses.

Q94.4.4.4 Quality System

The quality system should function in such a manner as to provide proper confidence that:

- b) the products or services actually do satisfy requirements and customer expectations;
- c) emphasis is placed on problem prevention rather than dependence on detection after occurrence.

Q94.5.1.2 Quality Loop

In the context of interacting activities within a company, marketing and design should be emphasized as especially important for:

- a) determining and defining customer needs, expectations, and the product requirements;
- b) providing the concepts (including back-up data) for producing a product or service to defined specifications at optimum cost.

Q94.5.2.4 Resources and Personnel

Management should identify quality factors affecting market position and objectives relative to new products, processes, or services (including new technologies) to allocate company resources on a planned and timely basis.

Q94.7.2 Product Brief

The marketing function should provide the company with a formal statement or outline of product requirements, e.g., a product brief. The product brief translates customer requirements and expectations into a preliminary set of specifications as the basis for subsequent design work. Among the elements that may be included in the product brief are the following requirements:

- a) performance characteristics (e.g., environmental and usage conditions and reliability);
- b) sensory characteristics (e.g., style, color, taste, smell);
- c) installation configuration or fit;
- d) applicable standards and statutory regulations;
- e) packaging;
- f) quality assurance/verification.

Q94.7.3 Customer Feedback Information

The marketing function should establish an information monitoring and feedback system on a continuous basis. All information pertinent to the quality of a product or service should be analyzed, collated, interpreted, and communicated in accordance with defined procedures. Such information will help to determine the nature and extent of product or service problems in relation to customer experience and expectations. In addition, feedback information may provide clues to possible design changes as well as appropriate management action.

Q94.8.0 Quality In Specification and Design**Q94.8.1 Contribution of Specification and Design to Quality**

The specification and design function should provide for the translation of customer needs from the product brief into technical specifications for materials, products, and processes. This should result in a product that provides customer satisfaction at an acceptable price that enables a satisfactory return on investment for the enterprise. The specification and design should be such that the product or service is producible, verifiable, and controllable under the proposed production, installation, commissioning, or operational conditions.

Q94.8.2.1 Design Planning and Objectives (Defining the Project)

Management should specifically assign responsibilities for various design duties to activities inside and/or outside the organization and ensure that all those who contribute to design are aware of their responsibilities for achieving quality.

Q94.8.2.2 Design Planning and Objectives

In its delegation of responsibilities for quality, management should ensure that design functions provide clear and definitive technical data for procurement, the execution of work, and verification of conformance of products and processes to specification requirements.

Q94.8.2.3 Design Planning and Objectives

Management should establish time-phase design programs with checkpoints appropriate to the nature of the product. The extent

of each phase and the stages at which design reviews or evaluations will take place may depend upon the product's application, its design complexity, the extent of innovation and technology being introduced, the degree of standardization, and similarity with past proven designs.

Q94.8.2.4 Design Planning and Objectives

In addition to customer needs, the designer should give due consideration to the requirements relating to safety, environmental, and other regulations, including items in the company's quality policy which may go beyond existing statutory requirements.

Q94.8.2.5 Design Planning and Objectives

The quality aspects of the design should be unambiguous and adequately define characteristics important to quality, such as fitness for purpose and safeguards against misuse should be considered. Product definition may also include reliability, maintainability, and serviceability through a reasonable life expectancy, including benign failure and safe disposability, as appropriate.

Q94.8.5 Design Review**Q94.8.5.1 General**

At the conclusion of each phase of design development, a formal, documented, systematic, and critical review of the design results should be conducted. This should be distinguished from a project progress meeting, which is primarily concerned with time and cost. Participants at each design review should include representatives of all functions affecting quality as appropriate to the phase being reviewed. The design review should identify and anticipate problem areas and inadequacies, and initiate corrective actions to ensure that the final design and supporting data meet customer requirements.

Q94.8.5.2 Elements of Design Reviews

As appropriate to the design phase and product, the following elements outlined below should be considered:

- a) Items pertaining to customer needs and satisfaction
 - 1) comparison of customer needs expressed in the product brief with technical specifications for materials, products, and processes;
 - 2) validation of the design through prototype tests;
 - 3) ability to perform under expected conditions of use and environment;
 - 4) considerations of unintended uses and misuses;
 - 5) safety and environmental compatibility;
 - 6) compliance with regulatory requirements, national and international standards, and corporate practices;
 - 7) comparisons with competitive design;
 - 8) comparison with similar designs, especially analysis of internal and external problem history to avoid repeating problems.
- b) Items pertaining to product specification and service requirements
 - 1) reliability, serviceability and maintainability requirements
 - 2) permissible tolerances and comparison with process capabilities;
 - 3) product acceptance/rejection criteria;
 - 4) installability, ease of assembly, storage needs, shelflife, disposability;
 - 5) benign failure and fail-safe characteristics;
 - 6) aesthetic specifications and acceptance criteria;
 - 7) failure modes and effects analyses, and fault tree analysis;
 - 8) ability to diagnose and correct problems;
 - 9) labeling, warnings, identification, traceability requirements, and user instructions;
- c) Items pertaining to process specifications and service requirements;
 - 1) manufacturability of the design, including special process needs, mechanization, automation, assembly, and installation of components;
 - 2) capability to inspect and test the design, including special inspection and test requirements;
 - 3) specification of materials, components, and subassemblies, including approved supplies and suppliers as well as availability;
 - 4) packaging, handling, storage, and shelf-life requirements, especially safety factors relating to incoming and outgoing

items.

CALL FOR ACTION

While the strength of VE implications varies between the excerpts and with the perspective of the reader, I propose a sufficient linkage exists to identify VE as a useful and, perhaps, necessary tool in satisfying the intent of the documents. It is in the best interests of the VE community to develop awareness, to understand and to promote the implementation of the ANSI/ASQC Q90 Series of quality systems standards.

REFERENCES

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