

ISO 9000 in Construction

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The number of ISO 9000 registered firms in the US and Europe is growing rapidly. Reasons for registration are retention of market share, customer pressure, trade in the European Community and desire to establish a functional quality management system. Construction contractors in Europe are seeking and obtaining registration. The trend toward registration may soon affect US construction contractors. Registration will require significant commitment of time and money for domestic contractors.

Key Words: ISO 9000, Quality Management System, Construction, European Community

Introduction

Markets and Attitudes Are Changing

These days, "quality" has everyone's attention in the construction industry. One quality management system receiving much attention lately is ISO 9000. Construction firms account for only a small fraction of ISO 9000 companies worldwide. However, the standards incorporate basic quality management principles that are similar for most industries (in fact, the standards are remarkably generic). This paper puts ISO 9000 in perspective for the domestic construction industry. Some new information is provided on European construction companies' adoption of ISO 9000. A history of the standards and how they were developed is included, as well as information on ISO 9000 companies in construction and other industries. The domestic market is increasingly affected by foreign competition. In 1980 only two of the 100 largest construction firms in the US were fully or partially foreign owned. In 1993, 22 of the largest 100 had at least partial foreign ownership (Lowder 1994). Trends toward registration in other industries could soon compel some US construction companies to seek registration. Insituform Technologies, Inc. in Memphis, TN, is currently seeking ISO 9001 registration for the manufacture of a popular licensed product for sewer lining and rehabilitation. The firm will seek registration for the entire manufacturing, research and development and construction operations in the US, Canada and Europe. In addition, Insituform is advising domestic utility contractors ISO 9000 registration will be required for installers of the firm's licensed product. Insituform's reasons for pursuing registration are access to European markets, anticipated requirements of the domestic market and establishment of a base for corporate commitment to quality. The company views ISO 9000 as a mechanism for long-term improvement through a continuous process of problem identification and corrective action (Matheson 1994). Domestic construction contractors are not likely to pursue registration without economic pressure. A prediction has been made that registration may soon be demanded by purchasers in the domestic construction industry. Many large domestic industrial manufacturers have received registration and may begin requiring registration for contractors bidding on private construction projects (Lew 1994). The United States Department

of Defense (DOD) has approved use of ISO 9000 standards in lieu of MIL-Q-9858A whenever practical ("Undersecretary" 1994).

Background of ISO 9000

International Organization for Standardization (ISO)

ISO was founded in 1946 to promote voluntary, manufacturing, trade and communication standards. The organization is based in Geneva, Switzerland, and includes 92 member countries and approximately 180 standard-drafting technical committees. The name "ISO" is not a jumbled acronym for The International Organization for Standardization. ISO actually refers to the Greek word, isos, meaning equal. The preferred pronunciation is one word, "ISO," not spelled out as "I-S-O". In any case, ISO has become the short name for the organization (Marquardt 1994). The US member representative for ISO is the American National Standards Institute (ANSI). The American Society for Quality Control (ASQC) formed the Technical Advisory Group (TAG) to technical committee 176 (TC 176) for ANSI. TC 176 drafted the ISO 9000 standards ("Registrar" 1992). The US TAG to TC 176 currently includes 141 participating members, 23 reviewing members and 67 observers (Arter 1994). The domestic version of the ISO 9000 standards is sometimes referred to as ANSI/ASQC Q90 ("Registrar" 1992).

ISO 9000 Standards

The ISO 9000 series of quality management and assurance standards were issued and approved in 1987 by 35 countries. TC 176 spent seven years developing the standards ("Registrar" 1992). By 1994, 80 countries had adopted the ISO 9000 standards as a national standard ("ISO 9000 Registered" 1994). The ISO 9000 standards evolved from government and non-government quality systems, chiefly MIL-Q-9858A and BS 5750 as shown in Table 1 ("More" 1992). Three major elements of the standard are the quality system, quality policy and quality management. Quality management includes determination and implementation of the quality policy. The quality system includes the procedures, processes, responsibilities and organization for carrying out quality management. Quality policy includes the overall goals of the organization with regard to quality as expressed by top management ("ISO Quality" 1994). The standards consist of five documents. Organizations may seek registration under ISO 9001, ISO 9002 or ISO 9003 as described in Table 2. The actual ISO 9000 document defines key quality system elements and serves as a guideline for choosing the standard for registration. ISO 9004 provides general guidelines for internal quality management. ISO 9001, ISO 9002 and ISO 9003 have overlapping requirements. The major sections of ISO 9001, ISO 9002 and ISO 9003 are shown in Table 3 (ANSI/ASQC Q90-1987 1987). ISO 9001, ISO 9002 and ISO 9003 cover a progressively smaller scope as shown in Figure 1. However, registration under ISO 9001 does not imply registration to ISO 9002 or ISO 9003. Likewise, ISO 9002 registration does not imply ISO 9003 registration. ISO 9001 is the broadest and most inclusive standard--providing "cradle to grave" coverage--encompassing the entire life cycle of a product from design to after-sales servicing. The major difference between ISO 9001 and ISO 9002 is the lack of design control. ISO 9002 covers quality in production and installation. ISO 9003 registration is appropriate when quality requirements are monitored only for final inspection ("Demystifying" 1993). In 1994, the ASQC

published revised standards ANSI/ASQC 9000-1, ANSI/ASQC 9001, ANSI/ASQC 9002, ANSI/ASQC 9003 and ANSI/ASQC 9004-1 revisions. The revised standards have the same basic structure as the 1987 standards. Most revisions to ISO 9001, ISO 9002 and ISO 9003 standards were for clarification purposes. The clause numbering system was modified to be consistent in each standard. An important change was the addition of servicing to ISO 9002 (Table 3) (Durand et al. 1994).

Table 1

Development of ISO 9000

Year	Event
1959	US Department of Defense (DOD) established MIL-Q-9858 quality management program
1963	DOD revised MIL-Q-9858 to MIL-Q-9858A ^a
1968	North Atlantic Treaty Organization (NATO) adopted quality program requirement divisions of MIL-Q-9858A to produce Allied Quality Assurance Publication 1 (AQAP-1)
1970	UK Ministry of Defense adopted provisions of ADAP-1 as Management Program Defense Standard (DEF/STAN 05-8)
1979	British Standards Institute (BSI) developed Commercial Quality Standard BS 5750
1980	ISO TC 176 began work on ISO 9000
1987	International Organization for Standardization issued ISO 9000 ^b
1987	American Society for Quality Control (ASQC) adopted ISO 9000 standards as ANSI/ASQC Q90 Standards
1987	BSI revised BS 5750 to be identical to ISO 9000 standards
1992	NATO began revising Quality System Standards to include ISO 9000
1994	US Department of Commerce (DOC) and DOD adopted ISO 9000 standards

^aMIL-Q-9858A is still in use and has not been revised since 1963.
^bThe standards issued were similar to BS 5750.

Table 2

Description of ISO 9000 Standards

ISO Standard	Scope
ISO 9000: Quality Management and Quality Assurance Standards-Guidelines for Acceptance and Use	Provides a guide to selection of the ISO 9000 series appropriate for a particular business. Registration is not actually issued under "ISO 9000."
ISO 9001: Quality Systems-Model for Quality Assurance in Design/Development, Production, Installation and Servicing	Registration under ISO 9001 is appropriate when the organization desires to demonstrate capability in design and supply of products.
ISO 9002: Quality Systems-Model for Quality Assurance in Production and Installation	Registration under ISO 9002 includes process control for production and installation of products, but not design*.
ISO 9003: Quality Systems-Model for Quality Assurance in Final Inspection and Testing	Registration under ISO 9003 demonstrates capability to detect and control non-conforming product at final inspection and testing only.
ISO 9004: Quality Management and Quality Systems Elements-Guidelines	Provides a guide for the development and management of a quality management system. Registration is not issued under ISO 9004.

*The 1994 revision includes service.

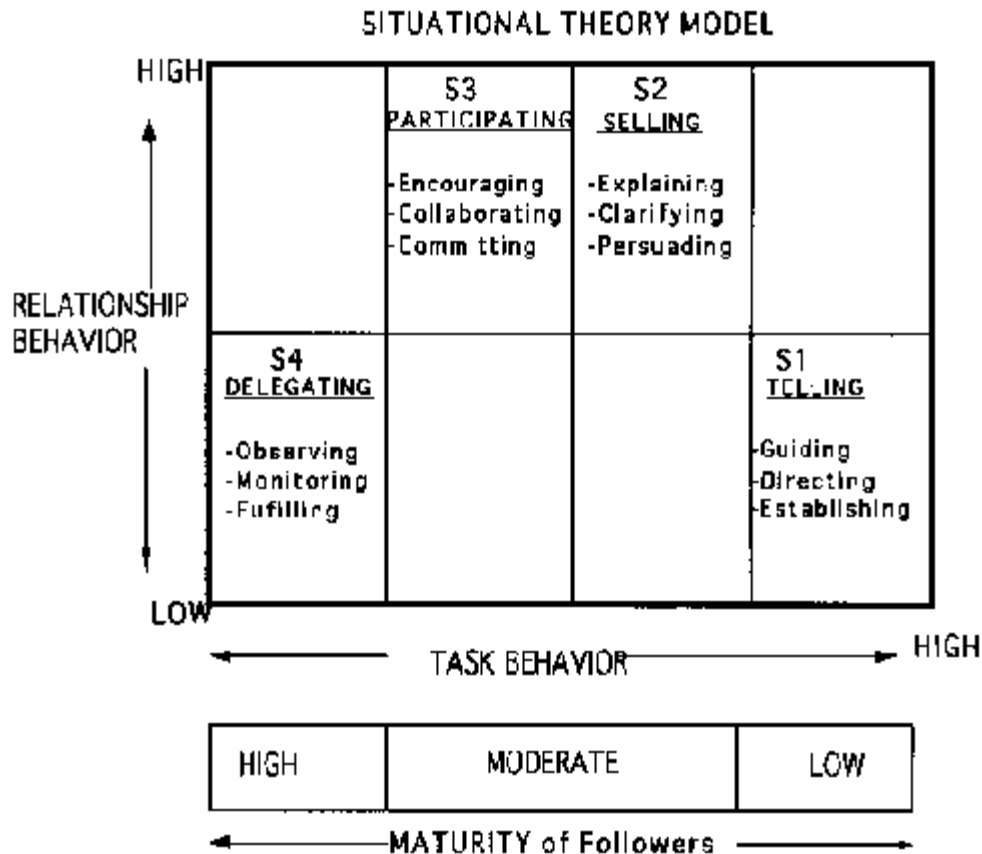


Figure. Situational Leadership Model by Hersey and Blanchard (1982)

The Registrar Accreditation Board (RAB)

Registrars certify or register companies' quality management systems. The RAB was formed in 1989 by the ASQC and is responsible for investigating the competency of registrars. Both groups are headquartered in Milwaukee, WI. The RAB issues accreditation to registrars in conformance with EC and ISO requirements for registrars. The RAB was the third national accreditation body formed world-wide. Selection of a registrar is complicated by refusal of some European companies to accept registration by foreign registrars. International recognition of a company's registration is not possible without mutual recognition of the issuing registrar's accreditation (Stratton 1992). Broad, mutual recognition by accrediting bodies throughout Europe has not occurred. However, the RAB has signed a memorandum of understanding (MOU) with Raad voor de Certificatie (RcV), the Dutch Council for Certification in the Netherlands which should lead to mutual acceptance of registrar accreditation in the US and Europe in the future. By August 1994, 52 registrars, including many foreign registrars, had received RAB accreditation ("ISO 9000 Registered" 1994).

The European Community (EC)

The existence of the large European Community trading block has increased demand for suppliers to obtain registration. Much of the recent interest by US manufacturers in the ISO 9000 standards is due to concern about access to European markets. The Single European Act of 1986

called for elimination of trade barriers between the 12 member states and the formation of a single internal market, known as EC 92. Products traded in the EC are subject to a complex product conformity process. The conformity assessment process created fear of exclusion from the European market. Because of EC 92, the European Community began to develop formal conformity assessment processes for products sold in the EC. All products sold in the EC are classified as regulated or non-regulated products. As much as 50 percent of US exports to the EC are subject to regulation (Spizizen 1992). Non-regulated products may be accepted in the EC by mutual recognition if the product meets a technical standard recognized by any EC member country. Regulated products are defined as having important health, safety or environmental impacts. Sale of regulated products is directly controlled by EC legislation in the form of "directives" that are binding on EC members. Directives are the result of the complex EC legislative process. Directives set standards for products by referencing appropriate technical standards for product design, product testing and frequently, the manufacturer's quality management system. Since the EC has adopted the ISO 9000 series as the model for quality management systems, in effect, "compliance" to an appropriate ISO 9000 quality management system has become a requirement for sale of many regulated products in the EC (Marquardt 1994). Regulated products account for approximately 15 percent of all products made and sold in the EC and roughly one-half of the dollar volume exported from the US to the EC (Spizizen 1992).

Demographics of Registered Companies

Any type of company can seek registration to an appropriate ISO 9000 standard. Because of the organizational structure of ISO, no "master list" of all registered sites in the world is maintained. Therefore, estimating the total number of ISO 9000 registered companies is difficult. An estimated 45,000 companies are currently registered in Europe. Accurate estimates for Asia, Africa and South America are not available (Brown 1994). More accurate figures are available for North America. In January 1993 there were approximately 700 registered firms in the US. By August 1994 at least 4,185 companies were registered in the US; Canada had at least 875 registered sites and Mexico had 75 to 100 sites (Campbell 1994).

Registered Construction Firms in Europe

A 1993 survey of the European Construction Industry Federation (ECIF) showed that the UK had 95 to 100 registered construction companies in 1993. An estimated 10 to 20 German construction companies held registration in 1993 ("Analysis" 1993). A single German registrar had at least 15 construction companies with registered sites in Germany, four in South Korea, one in Chile and one in India by June 1994 (TÜV 1994). The Czech Republic had the next most registered firms with 79. Switzerland had no registered construction companies at the time of the survey, but reported that 20 firms were expected to receive registration. Belgium, Spain and Portugal reported no registered construction companies. The number of registered construction companies and registrars reported for ECIF countries is shown in Table 4. ECIF members stated the main reasons for construction companies to obtain ISO registration were demands of clients and internal economic reasons. Components of the ISO 9000 standards most difficult to comply with were internal quality audits, contract reviews, process control, procedure writing, documentation, assessment of subcontractors, control of non-conforming products, corrective

action and interpretation of (all) standards. Guidelines for ISO 9000 implementation in construction companies are available in 10 of the countries represented. The survey reported that in eight countries the bodies responsible for registering companies held legal status (Table 4). The ECIF members responding for six countries were in favor of requiring construction companies to be registered as part of a qualification system. The UK strongly opposed mandatory registration. A majority of the ECIF members were interested in participating in the development of a European Guide to assist construction companies in obtaining registration ("Analysis" 1993). Concerns over requirements for registration in the German construction industry has led to sponsored research at Ruhr University at Bochum by a working team specializing in tunneling and pipeline maintenance. Many construction firms not holding registration nonetheless have procedures in place that are consistent with ISO 9000 requirements. Many European construction professionals are engineers by training and are used to meeting technical standards and have less expertise in the organizational requirements of ISO 9000. ISO 9000 is described as an optimization process for the organization of a company and the technical processes of the company. Elements of the ISO 9000 standard can be described as "hard" elements referring directly to production and "soft" elements that include elements of management such as management responsibility and quality system principles (Table 3). Many elements of management are independent of the type of work the company performs. Companies should find more help available in adopting the "soft" elements because many registered firms, while not construction firms, have similar management functions. Construction companies have many different production techniques. Companies face difficulty in determining the depth and scope required in documenting procedures. "Hard" elements should be more difficult to adopt because the elements are more likely to be company or industry specific. (Stein 1994).

An UK listing of registered companies included more than 500 listings for construction companies in 1994. Many companies had more than one registered site (DTI 1994). ISO 9000 companies in the UK are found in nearly all sectors of the commercial and industrial construction industry as well as engineering. The UK version of ISO 9000 is known as British Standard 5750 (BS 5750). Important reasons UK construction companies sought registration included customer demands, marketing advantages and the opportunity to begin building a corporate quality culture (Pateman 1994). The Construction Industry Training Board in the UK has produced a guide for implementing a quality management system in a construction company and a guide to ISO 9002 registration for construction companies ("Guide" 1991).

The UK construction firm Crispin & Borst achieved registration to BS 5750-2 (ISO 9002) in June of 1993. The effort took more than two years. The firm hired consultants to assist in documenting the company's existing procedures. A six-member inter-departmental management team reviewed the work to produce a set of procedures that could be carried out without significant extra work. A consultant assisted in comparing the written procedures to BS 5750 and addressing items needed to comply. The system was put into operation throughout the company for about six months prior to a successful registrar's audit (Sims 1993).

Table 4

ISO 9000 Registered Construction Enterprises and Registrars in the European Construction Industry Federation (ECIF)

Country	Construction Companies	Registrars
Austria	not reported	not reported
Belgium ^a	0	7
Switzerland ^b	0	2
Czech Republic ^a	79	2
Germany	10 to 20	5 to 15
Denmark ^{a,b}	10 to 15	2
Spain ^a	0	1
France ^a	2 to 3	3
United Kingdom	95 to 100	5 or 6
Greece	not reported	not reported
Hungary	not reported	not reported
Italy ^b	5	0
Ireland ^{a,b}	25	1
Iceland	not reported	not reported
Luxembourg	1	0
Norway	not reported	not reported
Holland	10	3
Portugal ^a	0	0
Sweden ^b	1 ^c	3
Finland ^{a,b}	1 or 2	3 or 4

^aCertifying bodies have legal status.

^bECIF member group favors establishing a notional qualification system requiring ISO 9000 certification of companies.

^cSpecialized enterprise

US Construction Companies

Six firms with a Standard Industry Code (SIC) in a construction division have US sites registered to a specific ISO 9000 standard as shown in Table 5. Several are well-known construction/engineering firms. However, none of the six firms' registration scope is directed at the commercial, non-industrial construction industry. One firm with a registered site is a wholly-owned subsidiary of the UK firm Trafalgar House which holds numerous registrations in the UK. Although classified under SIC 1500, Building Construction, the firm's scope is chiefly design and construction in the process plants. Two firms hold ISO 9001 registrations under SIC 1600, Heavy Construction. The registration scopes include chemical and petrochemical facilities and the oil and gas industry. Three firms hold ISO registrations under SIC 1700, Construction Special Trade Contractors. The firms include a construction/engineering field office serving a Monsanto Chemical plant in Gonzales, FL, a designer and installer of specialized communications and medical systems and a manufacturer of steel roofing products ("Registered" 1994).

Table 5

Companies with ISO Registered Sites in the US with Construction SIC Codes

COMPANY/SCOPE	REGISTRATION
SIC 1500 Building Construction—General Contractors and Operative Builders John Brown, Division of Trafalgar House, Inc. Design, procurement, project management, validation documentation, management of site construction and installation of process plant and facilities projects	9001
SIC 1600 Heavy Construction Other Than Building Construction – Contractors Fluor Daniel, Inc. Engineering, procurement, project management, construction and maintenance services	9001
The M.W. Kellogg Company Project management, engineering, procurement, construction and field services for the oil, gas, petrochemical and chemical industries	9001
SIC 1700 Construction – Special Trade Contractors Fluor Daniel, Inc. Construction and maintenance services	9002
Loral-Western Development Labs Design, manufacture, installation and servicing of medical imaging and information systems; distributed simulation and modeling systems; reconnaissance systems; command control, communication and intelligence systems; satellite communication ground terminal training and learning systems and information systems	9001
Roof Tile Manufacturing Company Manufacture of steel roofing tiles and accessories	9002

The Power Division of Black & Veatch is seeking ISO 9001 registration for design, construction management and procurement in Kansas City, MO. The site includes about 1700 employees. Richard White, head of the Power Division believes that ISO 9000 certification will be required for US architectural/engineering or construction/engineering firms desiring to work overseas (Fairweather 1994).

Conclusions

ISO 9000 standards outline a framework for a basic quality management system. The emphasis is on management procedures. Most domestic construction contractors face little pressure to pursue ISO 9000 registration. However, ISO 9000 can serve as a platform to establish a primary quality management system and introduce more advanced quality management techniques. Establishment of quality circles would be helpful to construction contractors seeking registration. The introduction of ISO 9000 in a construction company may be difficult because the management of the company will be open to scrutiny, and criticism is often difficult for management to endure. Changing attitudes and competition in a global market have focused management attention on quality.

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