KING FAHD UNIVERSITY OF PETROLEUM & MINERALS
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Construction Contracting and Administration

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"A SUMMARY Of CONTRACTORS QUALITY SYSTEMS ASSESSMENT TO ISO 9000 THESIS"

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TABLE OF CONTENT

INTRODUCTION

Problem Statement

The evolution of Quality in all aspects of life has become more and more tangible. This interest in quality is now very obvious in all types of business. Customers are now more demanding of quality. They do not only require their supplier to provide quality products and/or services, but also require them to operate quality systems that provide them with confidence in getting consistent quality.

The emphasis on quality is also demanded in the construction industry. However, anyone who has a little knowledge of the construction industry would associate it with poor quality and high risk. This has been the construction industry's image for a long time. One of the possible solutions to overcome the poor quality associated with the construction industry is to introduced and implement quality system standard.

This thesis is mainly a case study intended to survey selected construction contractors regarding their quality systems. Contractors' quality system elements are studied and compared with the requirements of ISO 9000 standard. The Eastern Province of Saudi Arabia is considered as the domain of the study.

Research Objectives

The objectives of this thesis are to :

1. Review ISO 9000 requirements and identify those requirements, which apply to construction industry.
2. Provide interpretation of the ISO 9000 requirements for its applications in the construction industry.
3. Assess the extent of implementation of ISO 9000 standard's applicable requirements by the selected sample of contractors.

Scope and Limitations

The research covers a sample of fifteen large construction companies in the Eastern Province of the kingdom of Saudi Arabia. The Chamber of Commerce in the Eastern Province recommended the contractors selected for the study because they are classified as major contractors, which have completed many construction projects. A longer list of contractors was contacted initially and their willingness to participate in the study assessed. The selected fifteen contractors are between the first two classes of the Chamber's classification for construction contractors.

LITERATURE REVIEW

Introduction of ISO 9000

ISO is the International Organization for Standardization, a worldwide federation of national standards bodies from 117 countries. ISO whose Central Secretariat located in Geneva of Switzerland, is a non-governmental organization established in 1947. ISO is not part of the United Nations Organization and its membership is not composed of government delegations, but is made of national standards institute or organizations one member organization per country. The Saudi Arabian Standards Organization (SASO) represents Saudi Arabia in ISO.

It is to be noted that “ISO” is not a name or an acronym. It was derived from the Greek word isos *which* means “equal”, and is the root of the prefix “iso-“ (e.g. “isometric” : equal dimensions). Hence, ISO was chosen as a name of the International Organization for Standardization as a reflection of its functions and because it is easy to follow.

Objectives of ISO

The objectives of the ISO is to develop world-wide standards to improve international communication and collaboration, and to promote the smooth and equitable growth of international trade. The output of ISO work is international technical agreements which are published as international standards. All of these international standards developed by ISO are voluntary, and ISO has no power to enforce their implementation in the member countries.

Evolution of ISO 9000 Standards

Since the Second World War, a trend has evolved which requires all material, methods, machines and manpower to be coordinated and checked to ensure they work together to provide customer satisfaction. This need was first formalized in the form of US Military standard MIL-Q-9858A as the first quality assurance standard issued in 1963. Although this old standard did not cover

internal auditing, it contains most of the current elements of ISO 9000 standard.

The MIL-Q-9858A standard was followed by many quality assurance standards issued by different countries until 1979 when the British standard BS 5750 was issued which became the basis for the birth of the international standard, ISO 9000, in 1987.

Structure of ISO 9000 Family of Standard

Currently the ISO 9000 family of standards (previously called series of standards in the 1987 first edition) consist of 17 standards. These are listed in attached table, ISO 9000 is not a single standard, it's a group or (family) of standards. ISO 9001, ISO9002 and ISO 9003 are used for contractual applications, i.e. supplier-customer business. Other standards in the ISO 9000 family are only guidelines, as their titles imply.

Certification to ISO 9000 Standard

As mentioned earlier, there are three standards among the ISO 9000 family of standards that are used for certification. These are ISO 9001, ISO 9002 and ISO 9003.

Before starting to explain the certification to ISO 9000 standards, one should understand the differences between 'first party assessment', second party assessment' and ' third party assessment are as follows :

- First party assessment (also called self-assessment) is performed by an organization to evaluate the adequacy of its own quality system and compliance with a standard such as ISO 9001.
- Second party assessment is performed by customers to examine the quality system of their suppliers.

However, second party assessment is expensive and time consuming for both parties (customers and suppliers), and this is why third party assessment and certification systems have been developed in order to reduce the need for multiple assessments and to provide impartial expertise as and when needed.

- Third party assessment is conducted by a body which is not party to any contractual relationships between clients and suppliers.

Certification bodies of quality systems provide confirmation that a supplier's quality system satisfiesISO9000 applicable standard, or equivalent. The purpose of such certification is to give assurance that the supplier is capable of supplying products or services against appropriate standards.

The certification process involves a complete review and evaluation of the supplier's quality system. The process includes an initial visit (also called pre-assessment visit) made by the certification body to learn about the supplier's operations and to evaluate his readiness. Supplier's documentation is reviewed for compliance with the applicable requirements of the ISO 9000 standard. Deviations from the standard (Called nonconformance) must be corrected by the supplier before the formal assessment is scheduled. The third party auditors verify by objective evidence that the supplier implements his own procedures, and that the procedures conform to the intent of the requirements of ISO 9000 standards. If the results of the assessment are satisfactory, the supplier will be granted the certificate. The certificate is usually valid for three years as the attached chart in the attachment section.
Companies whose quality systems are certified to ISO 9000 standard will be subjected to periodic follow up audits by the third party (called surveillance visits) to ensure that their quality system is continuing to function effectively. Surveillance visits are usually conducted every six months.

ISO 9000 Standard in Saudi Arabia

In Saudi Arabia, the number of certified companies has increased from 4 in the beginning of 1993 to 98 in the end of 1995.
Independent quality system certification services are available to the local companies by:

- Saudi Arabian Standardization Organization (SASO)
- International bodies who have offices in Saudi Arabia, i.e. the society Generale de Surveillance (SGS), the American Bureau of Shipping (ABS-QA) and the Technicher Uberwachungs Verein (TUV).
- International certification bodies who have offices out of the Kingdom such as the British Standard Institute (BSI), LIoyed

Register, Germanischer LIoyd, Det norske Veritus (DnV) and Bureau Veritus, etc.

Other national companies are also planning to enter the quality systems certification arena.

ISO 9000 and TQM

Total Quality Management (TQM) is a company-wide effort that involves every person in an organization to improve performance. It penetrates to every aspect in the organization and puts quality as a fundamental objective.

TQM philosophy which is based on management commitment, as the name implies, focuses on:

- Continuous process improvement and innovation
- Customer and suppliers (both internal and external) involvement
- Team work
- Education and training

In an effort to achieve:

- Customer satisfaction
- Cost effectiveness, and
- Defect-free work

ISO 9000 is a route to TQM, they are complementary to one another. For companies who are implementing TQM, installing ISO 9000 will be relatively straightforward. On the other hand, if a company is planning to implement TQM, it can use ISO 9000 as a vehicle. There is no contradiction between TQM and having a quality assurance system that is built to ISO 9000 standard. In fact, the two systems can be integrated to achieve the TQM/QA common goals. In addition, quality assurance provides measurement, which any TQM needs for monitoring continuous improvement.

ISO 9000 and the Construction Industry

Procurement of construction projects is not simple. The existence of legal contracts no guarantee that the client will ultimately be satisfied with the completed project. Even if after a problem occurs and the owner (client) of a project eventually obtains compensation by arbitration, the client cannot

obtain replacement. He is left wit the patched-up original which will probably be a continuing source of irritation and unanticipated expense.

Therefore, the client requires the contractor to have an in-house effective quality system that can give him the confidence or assurance that he will get a quality constructed facility on his land. This is what is called “quality assurance system”.

Quality systems involve internal and external aspects. Internal quality systems cover activities aimed to provide confidence to the management of an organization that the intended quality is being achieved

On the other hand, external quality system covers activities aimed to provide confidence to the client that the supplier’s quality system will provide a product or services that will satisfy his quality requirement. This is called “quality assurance systems”. Contractor’s quality assurance system is very important to the client, who will gain confidence that ‘ getting it right first time’ will be the contractor’s norm.

Interpretation of ISO 9000 standard in the construction industry

As mentioned earlier, ISO 9001 is the most comprehensive standard among the ISO 9000 family of standard. Hence, in this section an interpretation of ISO 9001 clauses to the construction industry is presented.

The standard consist of four main sections following the “Introduction” section, as follows:

1. Scope and field of application
2. References
3. Definitions
4. Quality system requirement

Section 4 addresses the twenty clauses of the quality system requirements. Therefore, the quality system requirements are numbered from clause 4.1 “management responsibility” up to clause 4.20 “statistical techniques”. Interpretation of these twenty clauses is in the attachment section. Each clause of the standard is discussed. First, the major requirements are listed. Then, details of specific requirement will be explained. The attached table lists the clauses of the standard and the specific requirements under the clauses that are discussed.

METHODOLOGY

Population and Data Collection

The research methodology start with thirty-four contractors was identified by the Chamber of Commerce and the contractors were screened, bringing the number down to fifteen. All contractors were contacted either by fax or by phone to ensure their willingness for participation. The screening process excluded the contractors who either declined to participate in the study because they were busy with current projects and preparing for bids

The fifteen construction contractors were visited and their delegated personnel were interviewed to obtain the needed information regarding their quality systems. All interviews included key individuals from the contractors management. Each interview took between 2 to 4 hours, and some interviews were done in two parts. It was very difficult for the company representatives to allocate the needed time for the interview.

The survey questionnaire was used during these interviews as a checklist, and completed to document the contractors' answers. This survey questionnaire consists of two parts. (See attachments section). The first part of the questionnaire is general and intended to get information about the contractors general interest in and perspective towards the .lSO 9000 standard, i.e. to know their familiarity, implementation experience, and status of certification or plans to be certified to ISO 9000 standard. The second part of the questionnaire, on the, other hand, consists of specific questions regarding the requirements of the ISO 9000 clauses. This part of the questionnaire was intended to get information about the various elements of contractors quality systems, and to determine whether or not the contractors have existing, documented and implemented systems that meet the requirements called for by the ISO 9001 clauses (except clause 4.19 "servicing" which was not covered by the questionnaire, as mentioned in the proposal). Every contractor was asked if he has an existing means in their quality system that satisfy each ISO 9001 clause, and if these means are documented and implemented.

Data Analysis

Upon completion of the interviews with the contractor's representatives, the data collected was analyzed per the following procedure:

1. Familiarity with ISO 9000 Standard
2. Certification of ISO 9000 Standard
3. Applicability and Benefits of ISO 9000
4. Difficulty of ISO 9000 Requirements
5. Implementation Obstacles
6. Reasons Behind Adopting ISO 9000
7. Contractors Quality System Elements and ISO 9000 Clauses

FINDINGS AND DISCUSSIONS

The following tables summarize the major findings of the first section of the questionnaire:

Familiarity of ISO 9000	Total	Applicability of ISO 9000	Total
Fully Familiar	6	Applicable & Beneficial	10
Partially Familiar	6	Have Reservation	2
Not Familiar	3	No Comments	3

Reasons behind Adopting ISO 9000	Total
Management Initiatives	6
Customer Requirement	6
Expect Demand in Future	3
No Demand	7

However, the second part of the survey output will be discussed in more details where Figures 1 though 3, can point out that that:

- Handling and storage (Clause 4.15) is the element of quality systems achieving the highest compliance of the ISO 9001 standard which the contractors have existing and implemented system for (note: all contractors agreed that packaging, preservation and delivery required by Clause 4.15 apply to products not for construction work). Contract review (Clause 4.3), inspection and testing (Clause 4.10) and inspection and test status (4.12) is in the second position.
- Internal quality audit (Clause 4.17) is the least element of quality systems of the ISO 9001 Standard which the contractors have existing and implemented system for. Design control (Clause 4.4) came in the second lowest ranking of the contractors' quality system. This is also due to the small number of contractors involved in the study that have design activities at all. Design control was followed by statistical techniques (Clause 4.20), and then management responsibility (Clause 4.1) and

corrective and preventive action (Clause 4.14) are the clauses of ISO 9001 standard which the contractors have little applications.

- On the other hand, inspection and test status (Clause 4.12) is the most element of quality systems which the contractors have documented system for. This is followed by inspection and testing (Clause 4.10) and then control of non-conforming product (Clause 4.13).

Internal audit (Clause 4.17), training (clause 4.18) and design control (Clause 4.4), are the least elements of quality systems, which the contractors have documented system for.

CONCLUSION AND RECOMMENDATIONS

The major factor of success to any quality system is the understanding, belief and commitment by the people who run it. If they understand it very well, they will believe in it, and when they believe in it they will implement it willingly, arid constantly.

The following major points have been concluded from the case studies:

1. Two contractors from the case studies have been already certified by third party to ISO 9002, and four others are in the process to be certified. Four contractors have long term plans to fully implement quality systems that meet ISO 9000 standard while three contractors are not familiar with the standard.
2. Out of seven contractors who claimed implementation, only two contractors have quality assurance systems that comply with all requirements of the ISO 9000 standard. Ten contractors have limited project-wide quality control systems while one contractor has no formal QA/QC system.
3. Three contractors have been requested by their major customers (Saudi Aramco, SABIC companies and the Ministry of Defense and Aviation) to comply with ISO 9000 standard.
4. Too much paper work, control of sub-contractors and vague terminology are the diffic41ties identified by contractors in implementing ISO 9000 standard in their companies.
5. High cost, resistance to change, limited ability of personnel, remote job sites, cultural and language differences are the obstacles identified by the contractors who implement or intend to implement ISO 9000.
6. Out of the twenty clauses of the ISO 9001 standard, "Handling, Storage and Preservation", "Contract Review" and "Inspection and Test Status" are the most used clauses of ISO 9000 standard that the selected contractors complied with.
7. "Internal Auditing", "Design Control", "Statistical Techniques", "Corrective and Preventive Action" and "Management Responsibility" are the least implemented clauses.

8. The contractor's documentation is lacking on most elements of their quality system.
9. There is a misconception by some of the contractors about some of the requirements. of the ISO 9000 standard such as disposition of non-conformances and corrective action and internal quality audits.
10. General weakness of the contractors quality systems includes control of sub-contractors and training, which are two major aspects that contribute to the quality of construction projects.
11. Statistical techniques are applied by eight contractors; six contractors are using them for measuring productivity, while one contractor is using them for sampling inspection and the other contractor is using them for controlling welding procedures.

The following points have been recommended from the case studies:

1. In order to get the best results of the standard, contractors should increase the level of awareness about ISO 9000 standard. This will eliminate misconceptions about ISO 9000 and support the implementation process.

2. Contractor quality systems should emphasis on the importance of internal quality audits, corrective and preventive action, design control (if the contractors who do design), statistical techniques and management responsibility. These mentioned elements of the quality system received less attention by the contractors.

3. Increase the agencies that can be classified as third party certification bodies in Saudi Arabia.

ATTACHMENTS

The ISO 9000 Family of Standards

Standard	Title
ISO 8402 : 1994	Quality management and quality assurance –Vocabulary
ISO 9000-1 : 1994	Quality management and quality assurance standards – Part 1 : Guidelines for selection and use
ISO 9000-2 : 1993	Quality management and quality assurance standards – Part 2 : Generic guidelines for the application of ISO 9001, ISO 9003
ISO 9000-3 : 1991	Quality management and quality assurance standards – part 3 : Guidelines for the application of ISO 9001 to the development, supply and maintenance of software
ISO 9000-4 : 1993	Quality management and quality assurance standards – part 4 : Guide to dependability program management
ISO 9001 : 1994	Quality systems – Model for quality assurance in design, development, production, installation and servicing
ISO 9002 : 1994	Quality systems – Model for quality assurance in production, installation and servicing
ISO 9003 : 1994	Quality systems – Model for quality assurance in final inspection and test
ISO 9004-1 : 1994	Quality management – and quality systems elements – Part 1 : Guidelines
ISO 9004-2 : 1991	Quality management – and quality systems elements – Part 2 : Guidelines for services
ISO 9004-3 : 1993	Quality management – and quality systems elements – Part 3 : Guidelines for processed materials
ISO 9004-4 : 1993	Quality management – and quality systems elements – Part 4 :Guidelines for quality improvement
ISO 10011-1 : 1990	Guidelines for auditing quality systems- Part 1 : Auditing
ISO 10011-2 : 1991	Guidelines for auditing quality systems- Part 2 : Qualification and criteria for quality system auditors
ISO 10011-3 : 1991	Guidelines for auditing quality systems- Part 3 : Management of audit programs
ISO 10012-1 :1992	Quality assurance requirements for measuring equipment – Part 1 : Meteorological confirmation system for measuring equipment
ISO 10013 : 1995	Guidelines for developing quality manuals

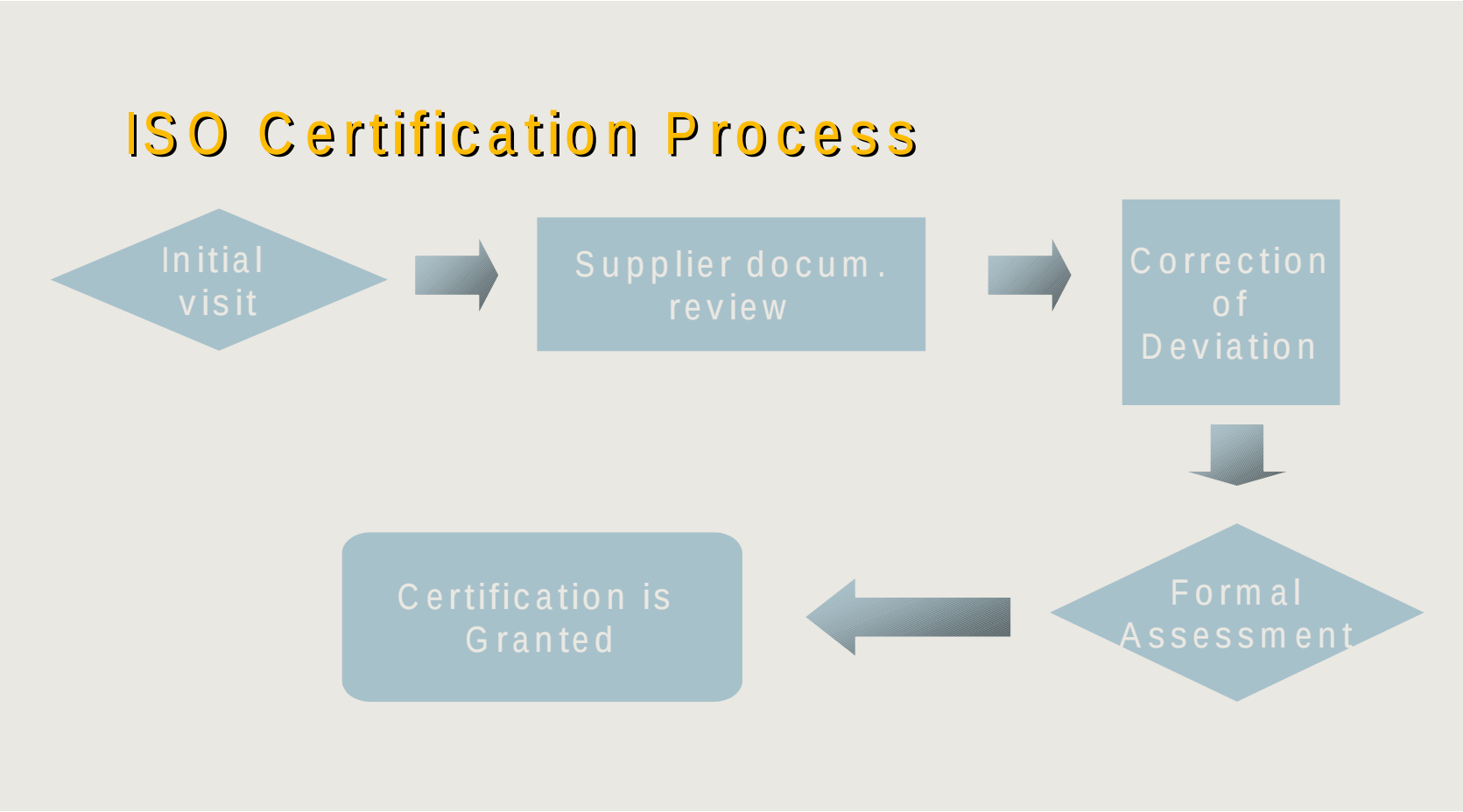
ISO 9000 Certification Growth in Saudi Arabia (42)

Date	Number of Certified Companies
January 1993	4
September 1993	10
June 1994	30
March 1995	53
December 1995	98

Clauses of the ISO 9001 Standard and the Sub-topic Under Each Clause

Title of the clause	Sub-Topics
Clause 4.1 Management responsibility	• Quality policy • Responsibility and authority • Resources • Management Representative • Management review
Clause 4.2 Quality System	• Quality manual • Quality system procedures • Quality plans
Clause 4.3 Contract review	•
Clause 4.4 Design Control	• Design plans • Design input and output • Design review and verification • Design validation
Clause 4.5 Document and Data Control	
Clause 4.6 Purchasing	• Evaluation of sub-contractors • Purchasing data • Surveillance of sub-contractors
Clause 4.7 Purchaser Supplied Product	
Clause 4.8 Product Identification and Tractability	
Clause 4.9 Process Control	• Equipment maintenance • Special processes
Clause 4.10 Inspection and Testing	• Inspection and test procedures • Receiving inspection and testing • In-process inspection and testing • Final inspection and testing • Inspection and testing records
Clause 4.11 inspection Measuring and Test Equipment	
Clause 4.12 Inspection and Test Status	
Clause 4.13 Control of nonconforming Product	
Clause 4.14 Corrective and Preventive Action	
Clause 4.15 Handling, Storage, Packaging and Delivery	• Handling • Storage and preservation • Packaging and delivery
Clause 4.16 Quality Records	
Clause 4.17 Internal Audit	
Clause 4.18 Training	
Clause 4.19 Servicing	
Clause 4.20 Statistical Techniques	

Certification Process of ISO 9000 Standard



The ranking of ISO 9001 clauses is presented in Figures 1 through 3.

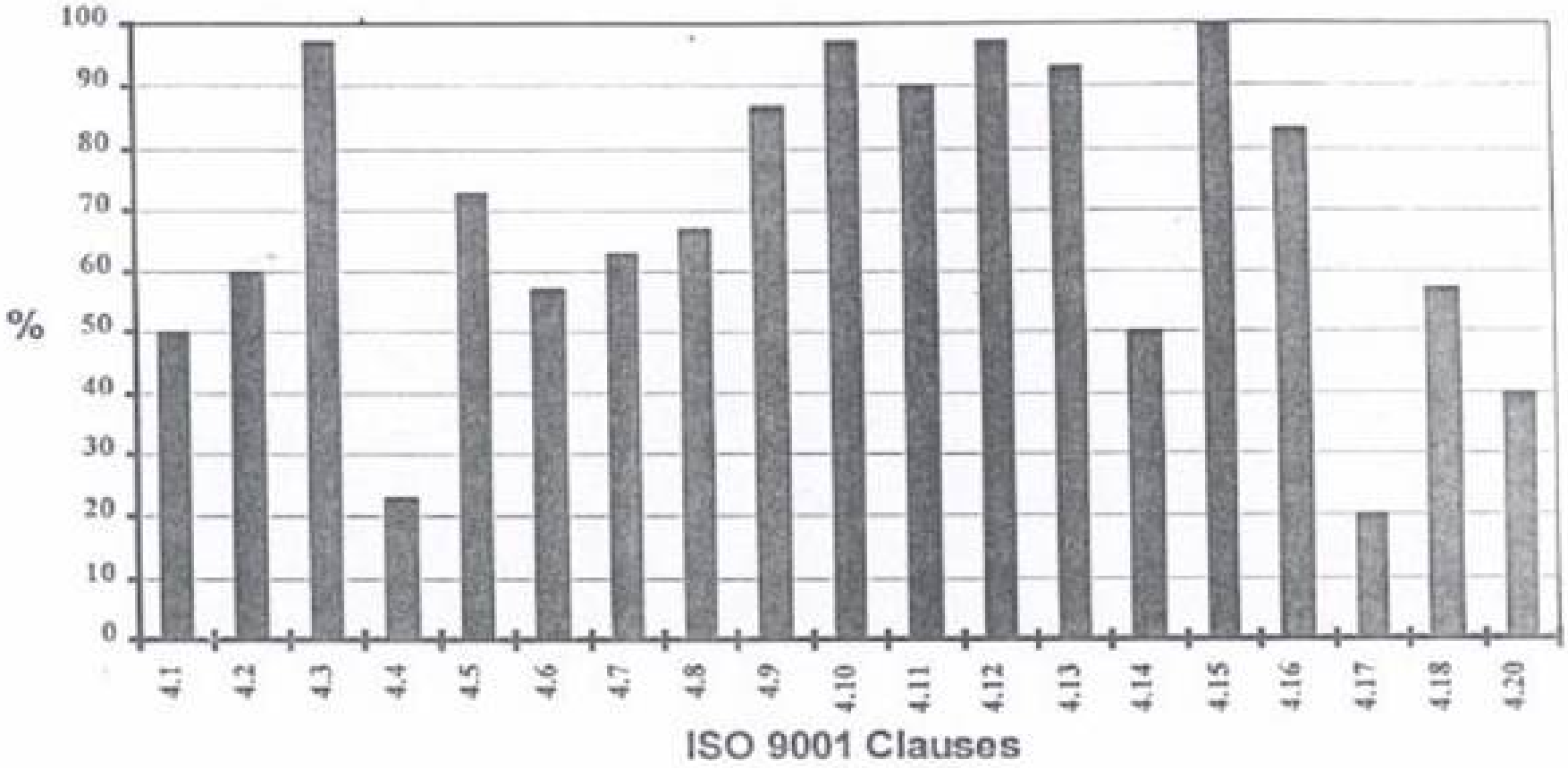


Figure 1 : Contractors Existing Quality Systems Elements Required by ISO 9001

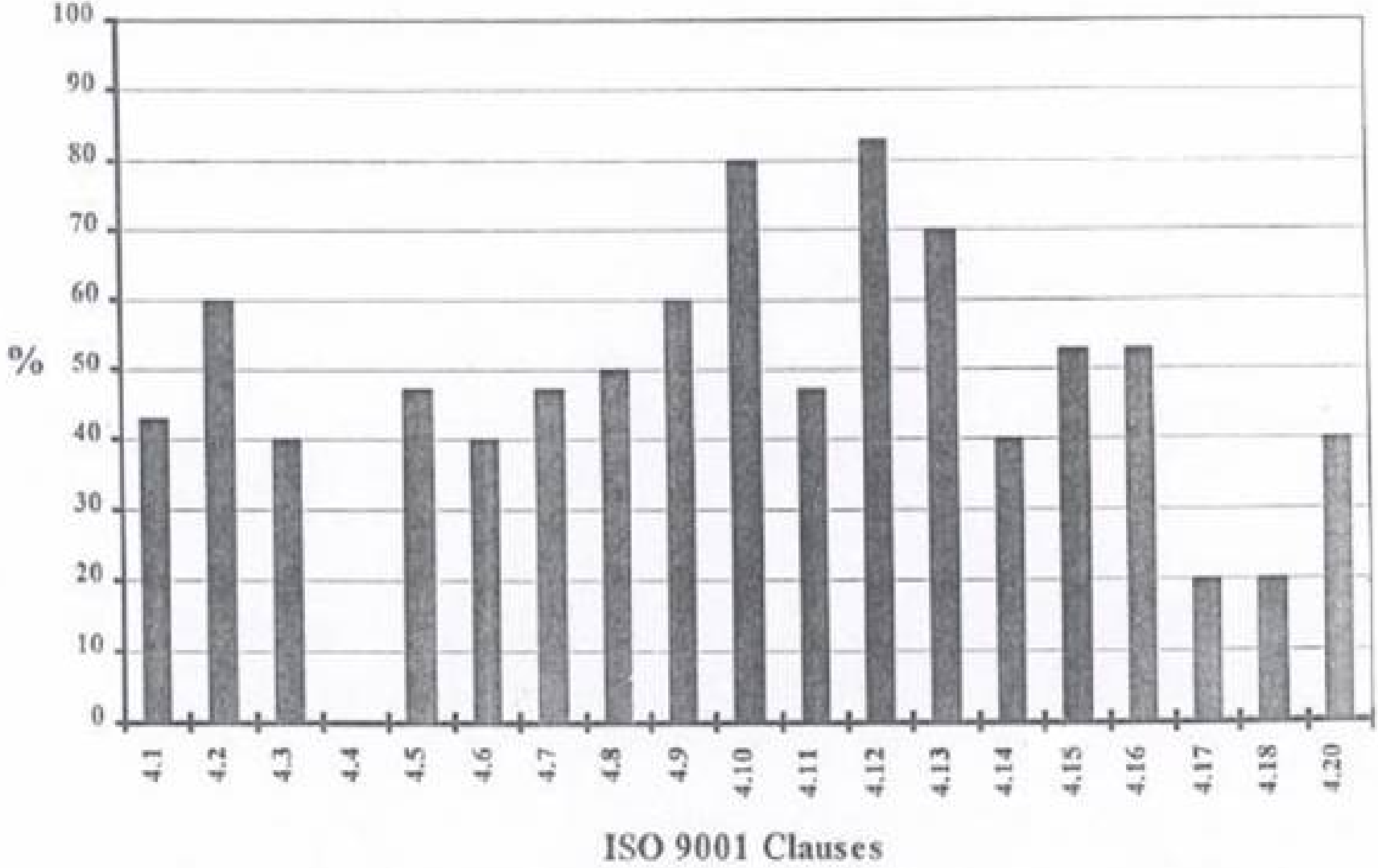


Figure 2: Contractors Documentation of Quality Systems Elements Required by ISO 9001

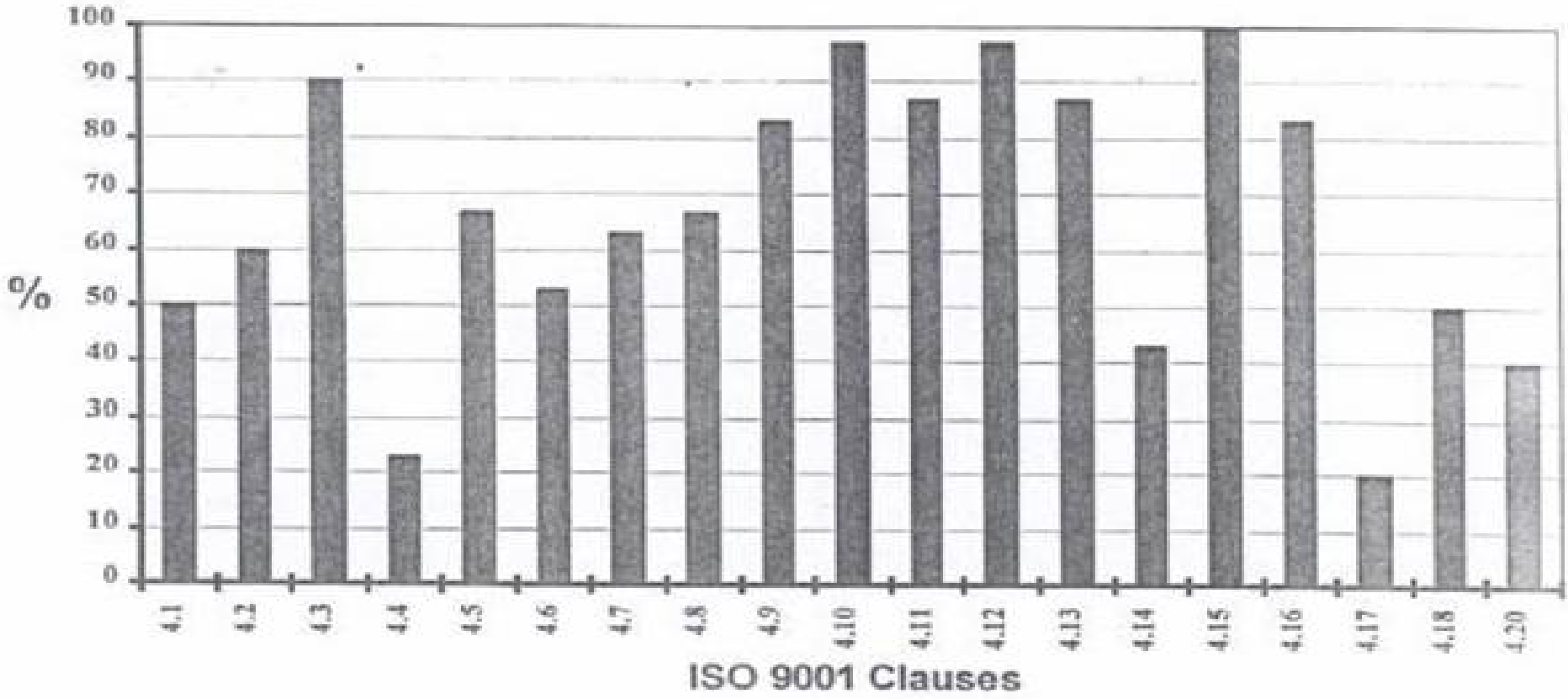


Figure 3 : Contractors Implemented Quality Systems Elements Versus ISO 9001