

Analysis of non-conformities from external audits

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Abstract

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Abstract:

The core of this thesis is doing an analysis of the most common non-compliances found during external audits from construction sector companies.

After more than a decade of Quality Systems implementation most of construction companies have currently seen how frequently non-conformities appear as a result of the unfulfillment of the requirements established by the standard ISO 9001.

This study presents an analysis of the actual construction industry obtained from the examination of external audit records from certification bodies. After analysing which non-conformities appear repeatedly, the result is compared to extracted reports from past years. The analysis of the non-conformity causes is performed for both samples, as well as, it is exposed what are the tendencies of its appearance in construction sector in the near future.

In conclusion some corrective and preventive measures are proposed, in addition to, continuous improvement plans which can be used by these organizations to increase customer satisfaction, competitiveness and eventually, fulfill standard requirements.

Keywords: Non-conformity, ISO standard, Quality Management System, corrective measures, external audit, construction sector.

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Project statement

For many years, the construction sector, like other business, have implemented Management Systems to better perform its processes. Having a quality management system gives additional value to these companies as well as allow them to be more efficient and competitive in the current market, characterized by a large economic recession.

Nevertheless, the construction industry presents great differences that make it unique. Organizations usually have problems on external certification processes, triggering non-conformities appearance, that is to say, a breach of standard requirements.

Next all the aforementioned, a proper study is required based on the analysis of the most common standard non-compliance in construction companies, as well as, describing the actions taken to deal with these non-conformities.

One of the key aspects of the study is based on reviewing external audit reports from certifying entities. Those reports belong to those construction companies who have detected non-conformities during their last certification processes.

Besides it is necessary to have an extensive knowledge about current standards as ISO 9001:2008, it is also essential to be aware of which processes are performed by certification entities in order to accomplish certification procedures.

Due to confidentiality, it is mandatory to establish a collaboration agreement with companies and certification bodies in order to make use of external audits records.

It should be appointed that without the collaboration of entities such AENOR 'Spanish Association for Standardisation and Certification' would have been impossible to develop this study.

It is fundamental to compare the analysed data with the information extracted from meetings with technical staff and available literature. Different perspectives must be taking into account in order to get a better analysis.

The goal of this thesis consists in identify those common non-conformities come of external audit records provided by certification bodies. Entities which evaluate Quality Management Systems on construction-companies.

In the same way, the underlying research try to improve the quality system implementation as well as answer questions associated to this matter.

What are the most frequent non-conformities on external certification processes from construction companies? How can be solved? What mayor problems lead these non-conformities appearance? How the quality management implementation has been evaluated in the last decade?

Questions that can only be answer throughout the development of this study.

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List of abbreviations

AEC	Asociación Española para la Calidad <i>Spanish Association for Quality</i>
AENOR	Asociación Española de la Normalización <i>Spanish Association of Standardization</i>
BSI	British Standards Institution
ISO	International Standard Organization
ITEC	Instituto de Tecnología de la Construcción de Cataluña <i>Construction Technology Institute of Catalonia</i>
OFI	Opportunity for improvement
OHSAS	Occupational Health and Safety Advisory Services
PDCA	Plan- Do- Check- Act.



CHAPTER 1

1. Introduction

With the current times in the construction field, having a management system gives added value to companies. Being a certified company give them strategic tools that reduce costs by minimizing waste and errors and increasing productivity. Implementing an ISO 9001:2008 certification helps companies to access new markets, ensures that products and services are safe, reliable and of good quality.

Nevertheless, some problems could arise during the certification process such the appearance of non-conformities; an unfulfilment of any standard requirement which slow down the certification process.

Many are the factors that have an influence in the appearance of those non-conformities but more of those are going to be analysed in order to find the most common ones and establish solutions.

2. Outline methodology and aim & objectives of the research

2.1. Aims & objectives

The goal of this Master Thesis is based on the analysis of the collection of records made by external audits during the quality certification process of construction companies.

The purpose of the analysis consists in the identification of non-conformities result from the unfulfilment of any requirement defined by the standard ISO 9001-2008. Furthermore, preventive and corrective actions are established as a result of the identification of the most common mistakes made by construction companies defining their production processes.

2.2. Outline methodology of the research

The methodology that is going to be developed on the thesis is based on the following steps:

- I. First of all, it is necessary to identify the entire certification bodies that are registered in Spain. After conducting a thorough search of the whole certification entities existent in Spain, AENOR has been chosen owing to the national importance of their certification procedures.
- II. Consequently, an appointment with the organization was dated in order to establish the different points that are going to be deal with.



- III. Regarding to this appointment, it was requested the access to audit records of some construction companies which have passed through a certificate process along the last decade. In addition it is stated the intention of formalizing a confidentiality agreement with the University Jaume I of Castellón.
- IV. Secondly, data was collected from the external audit process as a result of a quality certification.
- V. After that, the records were analysed.
- VI. The most common mistakes made by the internal company processes were identified.
- VII. Finally preventive actions were established to the overall construction sector in order to enhance Quality Management System improvement and strategy policy against the market.



CHAPTER 2

3. Literature review.

3.1. Introduction to management systems.

A quality management system is considered as a part of the overall company management system that includes the organizational structure, responsibilities, practices, procedures, processes and resources owing to identify and carry out the quality policy. (ISO 9001:2008)

The standard ISO 9001:2008 sets out the criteria for a quality management system and is the only standard in the family of ISO 9000 that can be certified.

It specifies the requirements for quality management systems applicable throughout the organization that needs to demonstrate its ability to provide products which meet customer needs and regulation requests. As can be seen the main goal is to increase customer satisfaction.

Some of the documents that should be submitted by the company according to its quality management systems are shown above.

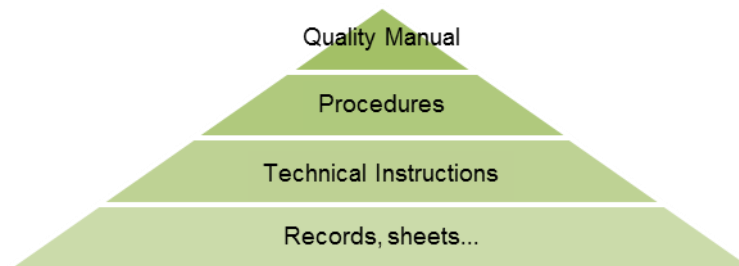


Figure 2.1: Documents submitted by an organization owing to its Quality Management System implementation.

Implement a Quality Management System, as can be expected, brings a sort of benefits.

The main benefit is based on upgrading the organization and business competitiveness; rewards associated with the reduction of costs, as well as, the reduction of response times. At the domestic level, the company gets a well-defined working structure, which encourages and develops self-discipline.

Every company that wish to improve its organizational performance must acquired 'eight quality principles' as ISO 9001:2005 shown in section 0.2. The eight quality principles are defined as follows (Improven Consultores) (Aenor, 2006):

i. Customer focused organization.

Organizations must meet customer requirements and struggle to exceed their expectations.



ii. Leadership.

Leaders should establish the global objectives and direction of the organization. They should create and maintain an internal environment in which people can become fully involved in achieving the common goals of the organization.

iii. Staff participation.

Staff is the essence of an organization due to their abilities which can be used for achieving company's goals.

iv. Process approach.

The desired result can be achieved more efficiently if the entire related resources and activities are managed as a process.

v. Management based on systems.

Identifying, understanding and managing an interrelated processes system focus on a given objectives improves the effectiveness and efficiency of an organization.

vi. Continuous improvement.

A continuous improvement should be a permanent aim of the organization.

vii. Decision making based on facts.

Effective decisions should be based on analysis of data and information.

viii. Beneficial relationship between supplier and distributor:

The organization and its suppliers are interdependent and by setting a beneficial relationship between them enhances the ability of creating add value. (Junta de Extremadura) (Aenor, 2006)

3.2. Current management systems.

In order to establish a good quality system, there are some international standards drawn up by the ISO organizations which gathered all the requirements that a company must satisfy for the purpose of meeting all these management principles previously presented

3.2.1. Quality management family

The ISO 9000 called 'Quality Management family' addresses various aspects of quality management and provide guidance and tools for companies and organizations who want to ensure that their products and services consistently meet customer's requirements, in other words quality is consistently improved. (International Organization of Standardization ISO webpage)

The ISO 9000 family is compound of the standards describe below:



- ISO 9001:2008, subject of our study, sets out the requirements of a quality management system.
- ISO 9000:2005 covers the basic concepts and language.
- ISO 9004:2009 focuses on how to make a quality management system more efficient and effective.
- ISO 19011:2011 sets out guidance on internal and external audits of quality management systems. This International standard provides guidance on:
 - Auditing principles
 - Managing audit program
 - Conducting internal and external audits.
 - Competence of auditors

The adoption of a quality management system should be a strategic decision of an organization. The design and implementation of an organization quality management system can be influenced by:

- Its organizational environment
- Its varying needs
- Its particular objectives
- The processes it employs
- Its size and organizational structure.

ISO 9001:2008 can be used by internal and external parties, including certification bodies, to assess the organization's ability to meet customers, statutory and regulatory requirements applicable to the product, as well as, the organization's own requirements.

It is known that an organization function effectively if it determines and manages numerous linked activities. Those activities must be able to transform inputs into outputs, in other words, processes. Often the output from one process directly forms the inputs to the next.

The scheme followed by the standard to establish a model of a process-based quality management system is shown in Figure 2.2. This illustration shows that customers play a significant role in defining the requirements as inputs. Monitoring of customer satisfaction requires the evaluation of information relating to customer perception as to whether the organization has met the customer requirements. As it is present in the standard ISO 9001:2008 the model shown in Figure 2.2. covers all the requirements of this International Standard, but does not show processes of a detailed level.

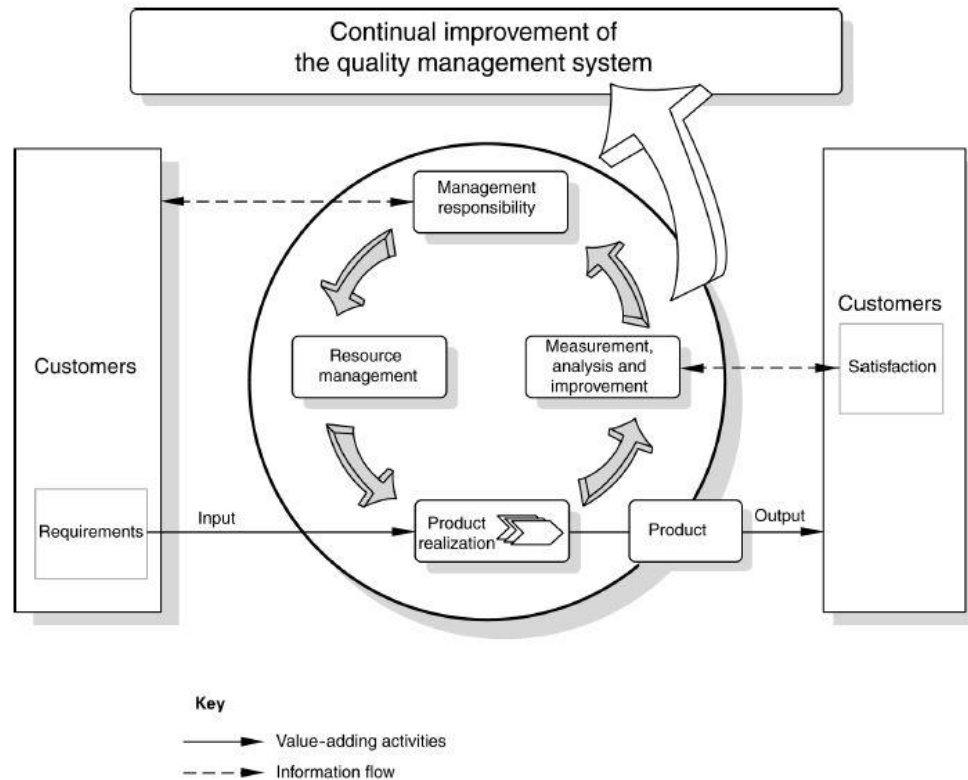


Figure 2.2: Model of a process-based Quality Management System (ISO 9001:2008)

In addition the methodology known as Plan- Do- Check- Act (PDCA) can be applied to all processes. PDCA can be briefly described as follow:

- Plan: Establish the objectives and processes necessary to deliver results in accordance with customer requirements and the organization's policies.
- Do: Implement the processes.
- Check: Monitor and measure processes and product against policies, objectives and requirements for the product and report the results.
- Act: Take actions to continually improve process performance.

3.2.2. Fulfilled requirements.

Some of the general requirements that an organization needs to prove in order to receive the certification of a quality management system are the following.

The organization shall establish, document, implement and maintain a quality, management system and continually improve its effectiveness in accordance with the requirements of this International Standard. (ISO 9001:2008)

The organization shall:

- Determine the processes needed for the quality management system and their application throughout the organization.



- Determine the sequence and interaction of these processes.
- Determine criteria and methods needed to ensure that both the operation and control of these processes are effective.
- Ensure the availability of resources and information necessary to support the operation and monitoring of these processes.
- Monitor, measure where applicable, and analysis these processes.
- Implement actions necessary to achieve planned results and continual improvement of these processes.

These processes shall be managed by the organization in accordance with the requirements of the International Standard.

Quality Management System procedures must include processes for management activities, provision of resources, product realization, measurement, analysis and improvement.

An 'outsourced process' is a method that the organization must implement for its quality management system and which should be performed by an external party such as a certification body.

Standards are considered as publications related to the certification process which means an international consensus and good practice relating to certification. Certification bodies are those entities accredited by national members of the International Accreditation Forum.

As far as the research analysis is concerned the former will be focus on the study of audit records gathered by AENOR, the first certification body in Spain that takes the ISO organization as a reference. It should not be forgotten, the fact that there are many others certification bodies. The AEC 'Spanish Association for Quality' gathered all the certification bodies that work in Spain. (AEC webpage)

The construction companies that were evaluated must be 'certified' or 'registered' by one of those certification bodies.

3.2.3. Outcome concepts from certification procedures – Non conformities

In a first approach to the matter a number of definitions should be extracted from the standards in order to understand some basic outcome concepts from certification procedures.

i. Non-conformities.

According to the definition provided in section 3.6.2 of ISO 9000:2005 nonconformance is defined as the non-satisfaction or a breach of the procedures defined and established by companies. For non-compliance also means the emergence of a different activity that the one which was previously planned, so could cause an adverse result on the provided service.



ii. Non-conformance correction.

A correction is an action which aims to delete a detected nonconformity according to the definition gathered in the paragraph 3.6.8. ISO 9000:2005.

iii. A corrective action.

In accordance with the definition provided in section 3.6.5 of ISO 9000:2005, a corrective action is an action taken to eliminate the cause of a detected non-conformity or other undesirable situation. The objective of the corrective actions is addressed to eliminate the cause/s that generated non-conformity and prevent possible problem recurrence, regardless of the immediate solution is adopted.

iv. Preventive action.

As it is disclosed in section 3.6.4. of ISO 9000:2005, a preventive action is defined as the measure/s carried out to eliminate the cause of a potential non-conformity or other undesirable situation. Preventive actions are basically anticipated actions which improve in time the appearance of an avoid problem. They can come from the analysis of the results, statistical trends or observation of a possible non-compliance cause.

In addition to the definitions defined above and related to non-conformities, there are some general aspects that should be taken into account in order to detect them.

Non-compliance can be identified during the performance of internal and/or external audits. The reason for the development of this thesis is the evaluation of non-conformities from external audits of construction business.

As a general guideline, detecting non-conformities must brought three different types of responses (Universidad de Cadiz, 2010)

- Correct non-conformance procedures owing to an immediate intervention
- Analyse the/s cause/s
- Design and implement corrective and preventive actions.

Furthermore all non-conformities encountered during an audit procedure should be gathered in a document composed of several sections.

A well-documented non-compliance is composed of three parts:

i. Evidence of non-compliance.

If there is no evidence, there cannot be any non-conformity.

ii. A **record** of the requirement on which the non-conformity has been detected.

It is necessary to clearly identify what is the requirement that has not been satisfied and has led to in non-conformity documentation.

iii. Non nonconformity statement.



This is the most important section of the non-conformities documentation.

It is based on the analysis records of the non-conformities' causes, the corrections that have been made and the corrective actions undertaken to correct those causes.

The statement of nonconformity should be self-explanatory, accurate, linguistically correct, unambiguous and be the most concise possible.

At the final point, the non-conformance should be closed during the **closing phase**.

Before closing non-conformities is necessary to ensure that there is an objective and documented evidence showing that the corrective actions have been fully implemented and are effective preventing reoccurrence. Only when the situation is satisfactory the certification entity can proceed to close the non-conformity. (Universidad de Cadiz, 2010)

Reached this point and taking into account the definition and different steps followed during the non-conformities evaluation, the different types of nonconformities gathered by ISO 9000:2005 should be exposed. The former International Standard defined two different types of non-conformities.

- **Major non-compliance**, in which the certification authority cannot grant the certificate.
- **Minor non-conformity**, or potential nonconformity.

There are measures and analysed methods that allow audits to detect non-conformities.

The preventive actions are used as a solution of potential non-conformities whereas the correctives actions are used for reclassifications or rework situations.

The **minor nonconformities** are defined by the ISO 9000:2005 as the 'failure to comply with a requirement which based on judgement and experience is not likely to result in management system failure'. It is considered as a single observed lapse or isolated incident and means a 'minimal risk of non-conforming product or service'.

According to BSI America, some situations characterized as minor nonconformities could be:

- A two month laps in the audit program
- A training not available record.

On the other hand, **mayor nonconformities** are established as the 'absence or total breakdown of a system to meet a requirement' (ISO 9000:2005). It could be the result of a number of minors nonconformities related to the same clause or requirement. Found one of these types of nonconformities during a company



certification will likely result in management system failure or significantly reduce its ability to assure controlled processes and products. Some examples of this type of non-conformities gathered by BSI America are:

- No documented procedure for a required process/activity
- Document changes routinely made without authorization
- No awareness program for the management system
- No future planned internal audits
- Insufficient scope
- Numerous minor non-conformities found.

Another definition gathered in the International Standard is the 'opportunity for improvement (OFIs). The former could be the result of:

- Any finding not classified as a nonconformance
- Any negative finding of a potential nonconformity will be classified as an OFI.
- There may be OFIs that are not potential nonconformities.

Everything discussed above leads us to understand which aspects should be evaluated during the quality certification of a company. But what are the steps followed by a certification body? At what time comes the evaluation of non-conformities?

3.2.4. Certification steps by a certification body.

The certification is the action carried out by a certification body which manifests the conformity of a company, product, process, service or person in relation to the requirements establish by a standard or a technical specification (AENOR webpage).

The steps involved for carrying out the implementation of a Quality Management System based on ISO 9001, are in essence as follows:

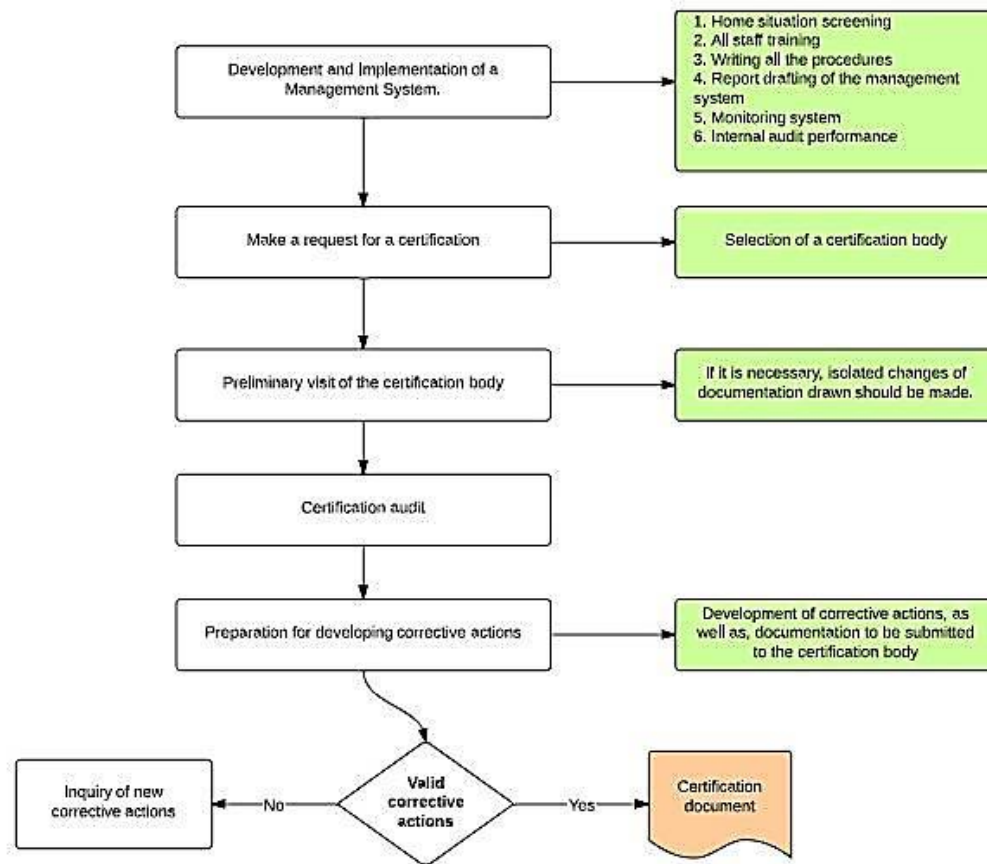


Figure 2.3: Quality Management System implementation.

A certification body should follow the following steps during the certification process. (Aenor, 2006) (Bureau Veritas, 2009)

I. Document analysis.

Before the certification process started, the certification body must analyse if the company has conducted a series of steps needed to comply before getting the certification.

a. Baseline detection:

- i. The company must perform a self- assessment, which enables them to define the weakest points of their procedures.
- ii. The Management Directives has to establish a commitment with the quality policy followed by the company.

b. All staff training



The whole organization should be involved in the implementation of the Quality Management System; consequently all the staff must be informed, trained and sensitized in meeting the objectives.

- c. Drafting of procedures, since the processes taking place in the organization.
- d. Drafting the Management System Manual.
- e. Implementation of the System
- f. Previous internal audit.

II. Advance review.

Through a preliminary visit of the certifying entity, the former should make specific modification if it considers that it is necessary. At this stage the auditors visit the organization with the following objectives (Aenor, 2006):

- a. Check the implementation level, as well as, the adequacy of the quality management system.
- b. Coordinate the initial audit plan
- c. Clarify any doubts that the organization may have about the certification process.

III. Initial audit.

During this stage the audit team examined the following steps defined as the ISO 9001 Assessment:

- a. The Management System Manual
- b. Objectives related to the management system
- c. Internal audit records.
- d. Results of the latest version made by the Management.
- e. List of standards, codes, and regulations relating to the product or services
- f. Organization chart.
- g. Any additional information deemed to be useful for the company or requested by the auditors.

Non- conformities encountered will be reflected in a report which will be discuss and deliverer to the company in a final audit meeting.

The formalized nonconformities always respond to one of the following three criterias:

- h. Be objective and caused by the breach of a requirement of the rule set by the organization.
- i. Be grounded on evidence and never in suspicions.
- j. Be understood and accepted by the organization.



From the time of identification, the organization must commit to analyse and develop corrective actions in order to eliminate the root cause.

IV. Corrective Action Plan

The non- conformance reports are submitted properly addressed by the organization responsible for auditing.

There are three levels of corrective actions:

- a. Corrective actions implemented during the audit process. In this case the non- conformance report is completed during the audit.
- b. Corrective actions could be closed by a documentary exchange between the organization and the auditor. In this case an additional visit is not necessary.
- c. Corrective action whose implementation should be verified in situ. The certification body offers a **supplementary audit** to the organization in order to verify in situ the closure of the corrective actions.

Corrective actions shall be implemented and closed within 90 days from the closing meeting unless the deadline wouldn't be observed. In this case a complete evaluation could be necessary.

V. Authorization.

Once the nonconformance reports have been properly closed, the audit report is closed and the head of the audit team recommends the certification of the organization.

VI. Applicability

In the specific case of certificate issued by AENOR, the registered company certification has a validity period of 3 years from the date of grant. During this term, follow-up audits are performed every year in order to assess whether it provides the system's effectiveness.

VII. Renewal

At the end of the three-year period, the certification body proceeds to conduct an renewal audit certificate.



3.3. Summary and problem formulation.

According to all the information discussed above, the goal of this Master Thesis is related to answer the following questions. What are the main non-conformities suffered by construction companies during their certification process? How can be solved? And the most important thing how can be prevented? Matter that is going to be developed along the research study due to interviews with certification entities and available bibliography.



CHAPTER 3

4. Currently times on the construction sector

As far as it is concerned the construction industry is considered as one of the main pillars of economic growth. Due to the proportion and variety of the products demanded, the construction sector is named as the 'thermometer' of economic activity.

In order to better understand the management of the construction sector, it is essential to identify the main differences in comparison to traditional industries.

4.1. Distinguishing characteristics.

The main **differences** found with respect to other economic sectors are caused by the construction sector own characteristics (Aenor, 2006):

- It is an industrial sector characterized by a nomad nature.
- Intensive and low-skilled labour force.
- High personnel turnover.
- Absence of manufacturing processes.
- Lack of uniformity in the use and production of raw materials.
- High complexity in most of the processes.
- Concentrated production characterized by mobile workers around a fixed product.
- Weather impact.
- Traditional sector with a large inertia which not facilitate the introduction on any changes.

Therefore, these differences could turn into specific serious **drawbacks** which could be treated as own features of the construction sector.

- There is no uniformity using different raw materials.
- There are found some difficulties in the organization and control of the work.
- Staff have very low motivation, bringing as a result, a quality lose.
- The complex specifications are often contradictory or confusing. They have often been poorly defined owing to unreliable and undefined initial data. Consequently the final quality could be significantly reduced.
- Complex organizations and temporary production centers not always facilitate the identification and clear communication of the responsibilities of each participant, which results in a quality decrease.
- The fluctuating and unpredictable economic market does not allow construction organizations to predict low activity periods, which hinders the implementation of reliable quality policies.



- Due to the high turnover and subcontracting of personnel, continuous training plans are, in most of the cases, unmanageable, especially in levels of low – skilled workers.
- The difficulty of protecting materials and works performed from rough weather condition.
- Tight project deadlines.

As a result of the different points discussed above, it is true that construction industry should be considered as an **unique industry**. In other words, the construction sector should be in progress according to the current changing environment.

4.2. Current situation and future forecast.

It is worth stressing the current situation of the construction sector, as well as, its future forecast across Europe.

First of all, it should be pointed that the evolution of the construction market is different for each of the subsectors in which it is divided to:

- Civil works
- Residential building
- Non- residential building
- Rehabilitation.

Regarding the size of the companies, three different categories are considered depending on the number of employees:

- Small business: companies with fewer than 10 workers.
- Medium- sized business: companies between 10 to 499 workers.
- Large business: companies with more than 500 workers.

4.2.1. Europe

As it is recorded by Euroconstruct in its report of June 2013, Europe is registering a recession period. The recovery period will only start once 2013 will be overcome.

The Euroconstruct report shows how the current situation of the construction industry is and will be in the near future.

Euroconstruct ensures that problems in Europe to restart economic growth have been felt particularly hard on the construction industry. The 2012 has been a year of sharp declines (almost -5,3%) and for 2013, the experts foresee a soften decline (-2,8%) to finally reach the bottom point. The forecast still committed to the industry to leave the negative zone since 2014. If expectations are met, the construction sector will increase around +0,5% in 2014 and +1,7% in 2015 when the industry will still be able to recover even the production levels of 2012.



In a detailed view by country, as it is shown by the graph below, it can be seen a mixed scenario.

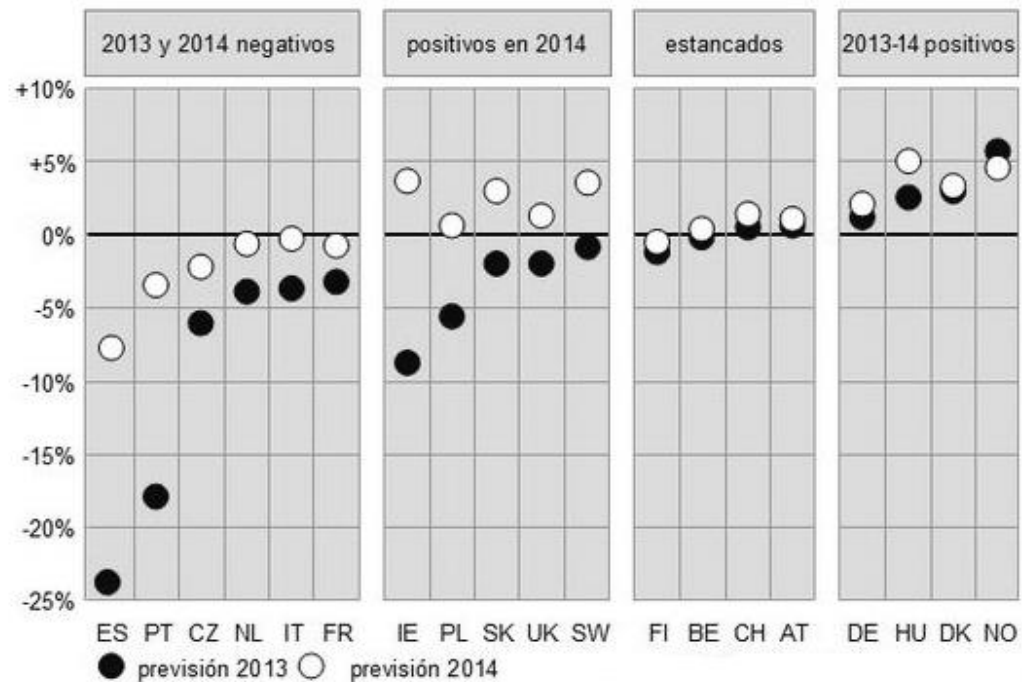


Figure 3.1: Europe's forecast in the near future.

Source: ITEC- Euroconstruct June 2013

Although 2013 will be negative for most countries, there is a small group compound by Germany, Hungary, Denmark and Norway which expect to experience growth in 2013 and also have positive forecasts for 2014 and 2015.

Almost all other countries will experience a sign change in 2014, but once again, there will be exceptions. In the case of the Netherlands, Italy and France, the crisis period will be extended another year and the return to positive zone is postponed until 2015.

Finally the Czech Republic and Spain may be the only two countries where the sector continues to decline in 2015 (Euroconstruct, 2013)

4.2.2. Construction subsectors evolution.

In connection with the evolution of the market and as it was told before, there are some differences between the sub-sectors in which are divided the construction industry in terms of future predictions.

- The **residential building** could not escape for suffering a dramatically decrease in 2013 of more than -3% as the other markets in Europe.



Nevertheless, it is the segment that concentrates the most optimistic forecast for both 2014 (+2,2%) and 2015 (+4,0%).

In *Spain*, as far as the hardest recession period is concerned, the experts predict positive data in terms of annual production variation in 2014 and 2015 with a growth of +5% and +15% respectively.

- **Non- residential building** has two difficult years ahead (-5,7% expected in 2013 and -1,6% in 2014) before it can reach the change of sign in 2015 reaching a moderate growth of +0,8% in terms of annual production variation.

On the other hand, in *Spain* the forecasts are slightly less favorable. The forecast estimate a sharp decrease of -17% in 2013, keeping still negative values in 2014 (-7,9%) and 2015 (-5,2%).

- **Rehabilitation** has symptoms which shown predicting behavior pretty similar from other markets whereas it is the segment in which the recession will be less intense. In the same way as other segments, the 2013 will be negative (-1,3%). Becomes positive forecast for 2014 (+0,7%) and 2015 (+1,3%).
- Finally, **civil engineering** is expected that after passing a slightly decrease in 2013 of -3,5%, Europe is entering a period of stagnation, with 2014 almost flat (+0,4%) and a 2015 little progress (+1,4%).

In *Spain* and according to recent published reports, the civil engineering segment is suffering the worst expectations: -42% in 2013, -18,5% in 2014 and 9,5% for 2015.

The graphs below describe the evolution on the construction sector in Europe and Spain in the upcoming 2 years.

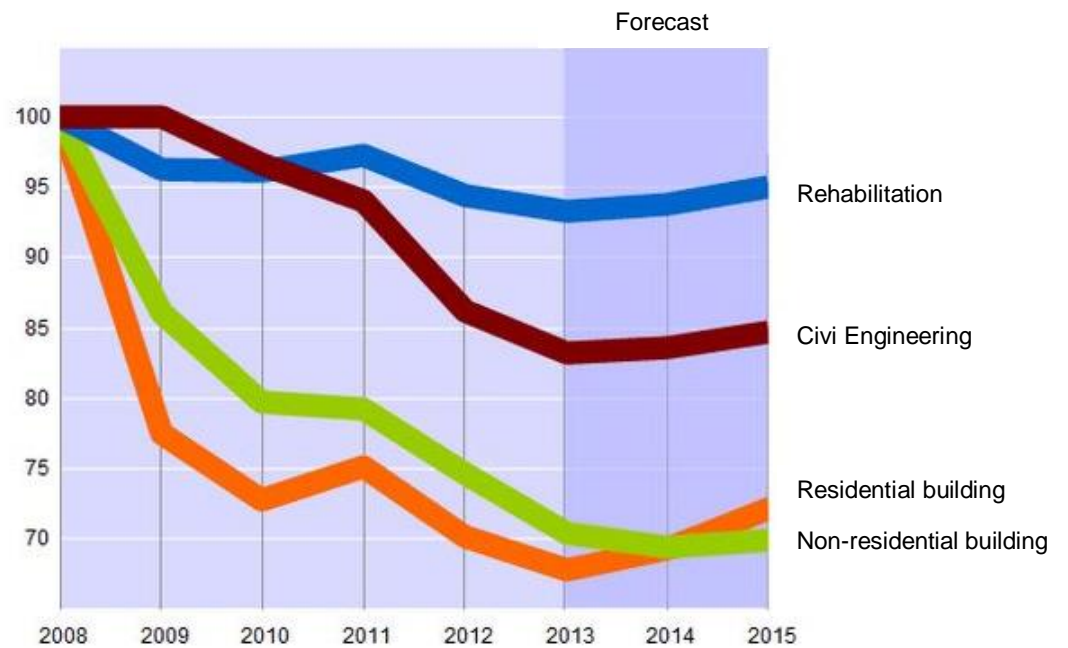


Figure 3.2: Evolution on the construction sector in Europe
Source: ITEC- Euroconstruct Junio 2013.

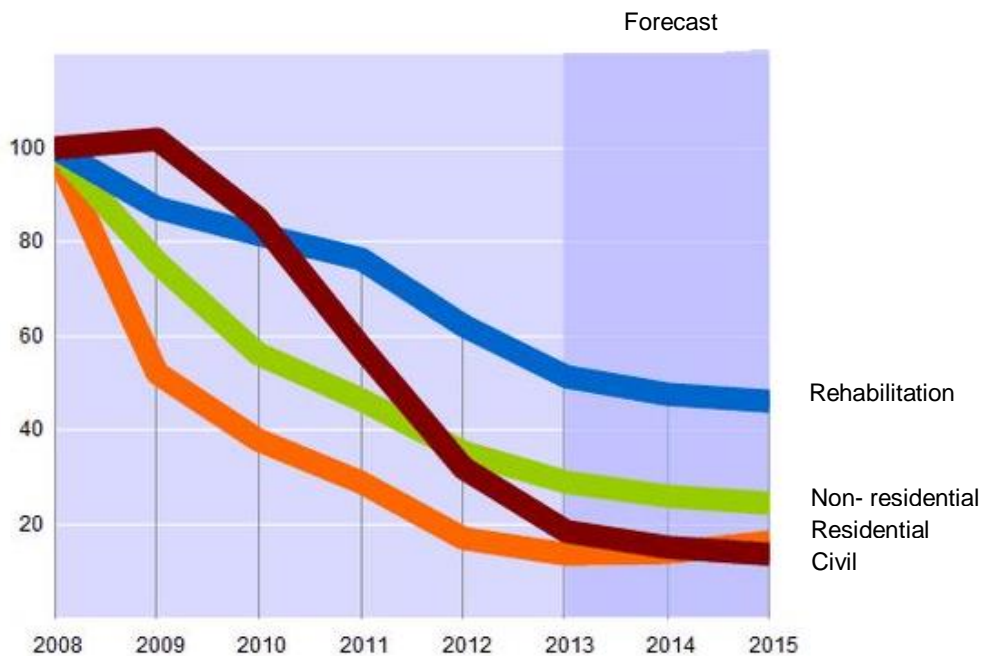


Figure 3.3: Evolution on the construction sector in Spain
Source: ITEC- Euroconstruct Junio 2013



5. Quality management tools.

With reference to the figures presented above and current market situation, the construction market as well as other industries such as healthcare or commercial sectors must meet clients' requirements in order to survive nowadays.

Being certified to ISO 9001 lets construction companies meet these entire requirements as well as differentiated themselves from the competition.

In current times, meeting ISO requirements could be considered as one of the strategic obligations for any company that wants to be recognized in the market as much as a factor on which depends the survival of any organization.

The adoption of a quality management system by an organization is a strategic decision that should be taken by the top managers. Owing to the fact that each organization has own features, the design and implementation of a quality management system is influenced by different aspects such as: the particular needs, particular objectives, output products, processes as well as the business size and organizational structure.

5.1. Implementation of a Management System

At first sight, the implementation of a quality management system by an organization consists of several steps (Aenor, 2006):

- Determine the needs and expectations of customers and other stakeholders.
- Establish the organization **policy** and quality **objectives**.
- Identify **processes** and **responsibilities** necessary for achieving quality goals.
- Identify and provide the **resources** needed owing to the achievement of quality objectives.
- Establish **methods** to measure the effectiveness of each process.
- Identify ways of **preventing nonconformities** and eliminating their causes.
- Establish and implement a process for **continual improvement** of quality management systems.

ISO 9001:2008 is considered as the most widespread quality management standard around the world. This International Standard promotes the adoption of a process approach based on developing, implanting and improving the efficiency of a quality management system in order to increase the customer satisfaction. Such an approach emphasizes the importance of:

- Understand and comply with the requirements.
- Consider the processes in terms of added value.
- Get results from performance and process efficiency.
- Continuously improvement of processes based on objective measurement.



The 'eight quality management principles' previously gathered in the section 3.1, of this thesis, must be used by top management in order to lead the organization towards better performance.

Although, it is going to be developed in more detail during the report, it is necessary to describe in a preliminary manner the benefits of implementing the standard ISO 9001:2008 on a quality management system:

- This standard is applicable to all kinds of products, all sectors of activities and to organizations of any size.
- Decreases the amount of documentation required.
- Provides a natural progression straight on the organizational performance improvement.
- It is compatible with other management systems such as the ISO 14001 'Environmental management systems'.
- Relate organizational processes to implemented quality management systems.
- Consider the needs and benefits of all stakeholders.
- It is always oriented towards continuous improvement and customer satisfaction.

6. Benefits of implementing a certification procedure.

It is widely believed that in the construction industry, quality is performed below the customers' expectations.

On the one hand the low quality achieved is due to the particular complexity of the sector. Each work is a prototype with a limited degree of industrialization with activities performed primarily in situ.

On the other hand there are more factors such the influence of climate and soil properties that could change the quality performed.

The large variety of agents that participate in the construction processes as well as the repeated failures during the transmission of information can be considered as the main causes of the quality dissatisfaction (Aenor, 2002)

Even though the construction sector cannot be considered as a ground-breaker industry adopting new management experiences, it can be seen as the first sector interested in improving and optimizing their processes although the inertia and culture represent a significant barrier.

The implementation of a quality management system reports, among others, the following benefits (Aenor, 2006):

6.1. Facing the market

A quality management system implementation:



- Promotes organization's development.
- Strengthens the position of the organization.
- Power brand image.
- Set up a competitive factor regarding the competition.
- Allows organizations to overcome technical barriers.

6.2. Facing the clients

- Loyalty and attraction of new customers through the provision of services that meet their needs and expectations.
- Improves communications with customers (companies, individuals, etc...)
- Increase customer confidence (companies, individuals, etc...)
- Increase customer satisfaction.

6.3. Before the management of the organization.

- Knowledge and clarification of internal processes.
- Improved processes and services.
- Save time and unnecessary resources.
- Better management of resources.
- Encouragement to get into a process of continuous improvement.

Briefly, the certification process provides the following benefits:

- Provides customer confidence
- Provides management transparency
- Improved access to foreign markets and avoid technical barriers.
- Prevents and reduces services and systems assessments.
- Facilitates customer choice.
- Increase the add value of organizations.
- Reduce insurance premium.
- Promotes accessing to new contracts or orders.

Multitude of agents are involved in the development of a construction work. It is essential to identify them in order to assess their contribution to the final product quality.

Each agent also functions as a client and producer of the manufacturing chain; so the expectations in terms of quality of each of the agent are different, depending on its location in the chain. The main actors involved along the product's production are:

- User
- Owner
- Sponsor
- Designer
- Material manufacturers



- Builder
- Maintenance companies.

Initially the first organizations to introduce standards and certify their processes were large organizations and manufactures of basic materials, such as, cement.

Gradually construction organization and the Administration were encouraging other agents (mainly their suppliers) to develop customized systems with these international standards, thus achieving greater flexibility and efficiency in managing projects.

At present and due to the economic recession period, small and medium size construction organizations are suffering some changes that leading them to disappear or going bankrupt. As a result, this organization's segment is considered as the main focus of study.



CHAPTER 4

7. AENOR's visit: Report Request

As it was discussed above, the scope of this thesis is based on the analysis and identification of common non-conformities as a result of certification procedures performed within the construction sector.

AENOR 'Asociación Española de Normalización y Certificación' is one of the biggest certification bodies in Spain. Throughout its more than 25-year history, it has shown great expertise in systems certification, getting a great national and international standing.

As a result, a research collaboration was asked to be made.

Under the date of May 20, 2013, an appointment was arranged at its headquarter offices in Madrid. I take this opportunity again to thank Mirta Noval, Head of Operations and Technology of AENOR, for her interest and dedication to this matter.

In the aforementioned meeting, external audit records were requested, specifically, records resulted from certification procedures of medium enterprises which have between 50 and 500 employees.

In particular, it was requested those section of non-conformities. In other words, any deviation respect to the international quality standard, ISO 9001:2008.

In the last decade, midsize construction companies have been the most affected by the crisis, suffering a greater number of deviations. Many of them are in bankruptcy now.

Consequently, they were evaluated only those certification procedures belonging to companies which luckily are not in the situation described above.

Fortunately, they have avoided being in creditor insolvency proceedings.

In order to conduct a study that covers the entire Spanish market, a selection of companies was made. It was chosen certification records from companies covering all the Spanish regions as well as including all sub- industries in which the construction sector is divided: rehabilitation, residential, non-residential and civil engineering.

7.1. Initial data: Non conformities trends.

Regarding to the held face to face meeting with the AENOR's Head of Operations, an initial idea of the current controversial situation was obtained. There were exposed ideas such as, the scope of the implementation of quality systems in the Spanish construction sector as well as the number and nature of non-conformities gathered in certification processes in the last years.



According to reports made by AENOR in 2001, the largest deviations showed by the construction sector certification processes were under the headings of:

- Purchases (section 7.4 in the current ISO 9001:2008)
- Documentation requirements (section 4.2 in the current ISO 9001:2008)

The major problems encountered on quality system implementations on construction companies were due to culture implanted in its work methodology, which usually gets away from the methodology implemented by other sectors.

- It tends to hide information that could cause problems in managing.
- Do not internalize management processes.
- There is no support from the administration and all the staff.
- Each project has different characteristics that make them unique. Different tenders, technical specification etc... In the same way problems caused by management challenges could be difficult to predict.
- Due to the crisis period that Europe is experiencing at this precise moment, national and even global construction companies tend to delay their audits, reason for the major deviations found in their certification processes.

AENOR, as national certification body, allows only two-months delay regarding to the annual review performed. If the company refuses to do it, AENOR will drop its certification.

At the present AENOR is developing a recapitulation of the construction industry features besides describing in more detail, how is being performed the quality system implementation in the entire sector. In draft form, the certification body is defining the guidelines on the consensus summarizing definitions that affect the sector and take them to a more competitive and successful market. The consensus includes all the members involved in the construction industry: from customers to producers.

AENOR as a certification body evaluates deviations or also named as non-conformances that a company could have during a certification process. Each company may submit a maximum of fourteen deviations made up by different subsections.

It is worth mentioning how in recent years, the certification entity has performed a large number of regulatory audits related to prevention of occupational risk, R&D management systems certification, accessibility as well as environmental risk assessments.



8. AENOR's visit: Report Analysis.

On June 2013 another meeting was formalized in AENOR offices in order to evaluate the certification reports previously requested.

More specifically, the object of this analysis was based on the 'non-conformities tables' evaluation included in the external audit reports conducted by AENOR in the last two years. Those reports belong to medium size construction companies which work along the Spanish geography.

Attention should also be taken to the confidentiality of the evaluated data. As it was required by the certification body all the data that can be related to different reported companies were obviated.

The study is only based on a statistical and frequency methodology in order to define which non conformities caused the majority problems during certification audits. The goal of this analysis is based on the definition of procedures and observations conducted by the companies in the sector which would lead them to a better adaptation to the client's needs, as well as, to achieve the highest quality in all the procedures performed.

8.1. Assessed reports.

A total of **sixteen** external audit reports were analyzed as an sample of the external audits procedures taken place in the last two years. Each one of these reports belong to different Spanish Autonomous regions. The result of their analysis shown a total of **forty** deviations, referred to **sixteen sections** of the International standard ISO 9001:2008.

It was observed that a large number of reports were the result of integrated certification processes compound of various standards:

- ISO 9001:2008 'Quality management systems'
- ISO 14001:2004 'Environmental management systems'
- OHSAS 18001 'Occupational health and safety'

8.1.1. *Non conformities table*

The analyzed section of the report is based on 'non conformities table' developed by AENOR in their external audit reports.

The scheme attached, see APPENDIX A, shows a typical 'non conformities table' followed by certification bodies.

8.1.2. *Specific comments and recommendations.*



All the nonconformities detected during the quality process of construction companies are registered in a table like the one shown, see APPENDIX A and APPENDIX B.

At the same time, it was observed that an external audit report is very extensive.

In the last part of the report there is a large section based on observations collected by AENOR. These comments gathered not only warnings of possible actions poorly defined but also processes which need attention from the company in order to eliminate possible non-conformities.

Most of the reports analyzed present an extensive observation sections. They are primarily related to the unfulfilment of the requirements gathered by Environmental and Occupational Risk standards recently implemented by companies in the construction sector.

The non-conformities table is composed of four different sections which helps the classification of the standard deviation:

- The **reference** of the non-conformity. Give a numerical order to the non-conformities owing to be index.
- The **description** of the non-conformity. Collect a brief overview of the cause of the unfulfilment of any of the requirements established by a standard.
- **Section of the Standard** referred to non-compliance appearance.
- Lastly, the **category of non-compliance**. The deviations are classified as minor or major non-conformities on a certification process.

A **major non-conformity** is defined as the result of a large number of research findings during the certification process, which proof a large number of repetitions.

Once non-conformities were defined along a certification process, the company must provide solutions through corrective measures. As soon as, the former were defined for all the non-conformities encountered, the certification body would give closure to them.

According to the procedure followed by AENOR and as long as there are establish more than **three or four** major nonconformities during a certification process, the company must undergo a **special audit** after six months. During the special audit the certification body certify that those not compliance previously found have been eliminated by the certified organization due to corrective measures.

8.2. Output results

The procedure, which was carried out, was firstly based on a study of the number, nature and cause of each one of the particular discrepancies recorded in all the analyzed reports.



It was evaluated each one of the **sixteen reports** which compound the sample. All the non-conformities were gathered following a frequency analysis. The result shows a ranking of the standard sections which collect the most common non-conformities.

The table below shows all the sections that compose the standard ISO 9001:2008 according to the next stage which is based on the non-conformities encountered relationship with the International Standard sections.

4.	Quality Management System
4.1	General requirements
4.2	Documentation requirements
5.	Management Responsibility
5.1	Management commitment
5.2	Customer focus
5.3	Quality policy
5.4	Planning
5.5	Responsibility, authority and communication
5.6	Management review
6.	Resource Management
6.1	Resource management
6.2	Human resources
6.3	Infrastructure
6.4	Work environment
7.	Product Realization
7.1	Product realization
7.2	Customer- related processes
7.3	Design and development
7.4	Purchasing
7.5	Production and service provision
7.5.1	Control of production and service provision
7.5.2	Validation of processes for production and service provision
7.5.3	Identification and traceability
7.5.4	Customer property
7.5.5	Preservation of product
7.6	Control of monitoring and measuring equipment
8.	Measurement, Analysis and Improvement
8.1	General
8.2	Monitoring and measurement
8.2.1	Customer satisfaction
8.2.2	Internal audit



8.2.3	Monitoring and measurement of process
8.2.4	Monitoring and measurement of product
8.3	Control of nonconforming product
8.4	Analysis of data
8.5	Improvement
8.5.1	Continual improvement
8.5.2	Corrective action
8.5.3	Preventive action

Table 4.1: Sections of the International standard ISO 9001:2008

The result showed the following order of deviations from the norm.

Standard Section details	Standard Section ISO 9001: 2008	% appearance
Customer- related processes	7.2	15,0%
Monitoring and measurement of product	8.2.4	15,0%
Planning	5.4	12,5%
Purchasing	7.4	7,5%
Customer satisfaction	8.2.1	7,5%
Document requirements (*)	4.2	5,0%
Management review	5.6	5,0%
Design and development	7.3	5,0%
Control of monitoring and measuring equipment	7.6	5,0%
Monitoring and measurement of process	8.2.3	5,0%
Corrective action	8.5.2	5,0%
Human resources	6.2	2,5%
Infrastructure	6.3	2,5%
Planning and product realization	7.1	2,5%
Control of production and service provision	7.5.1.	2,5%
Identification and traceability	7.5.3	2,5%

Table 4.2: Non-conformities appearance, Analysis 2013

*A non-conformity appearance on paragraph 4.2.3 'Document control'

As the analyzed sample shows, some of the most generalized problems found during the implementation and maintenance of quality management systems are related to:

- Planning
- Customer-related processes



- Customer satisfaction
- Monitoring and measurement of product
- Purchasing
- Management review.

The graph below shows the percentage of non-conformities detected in AENOR's external audit reports. It represents, in a graphical way, the results gathered in the table 4.2.

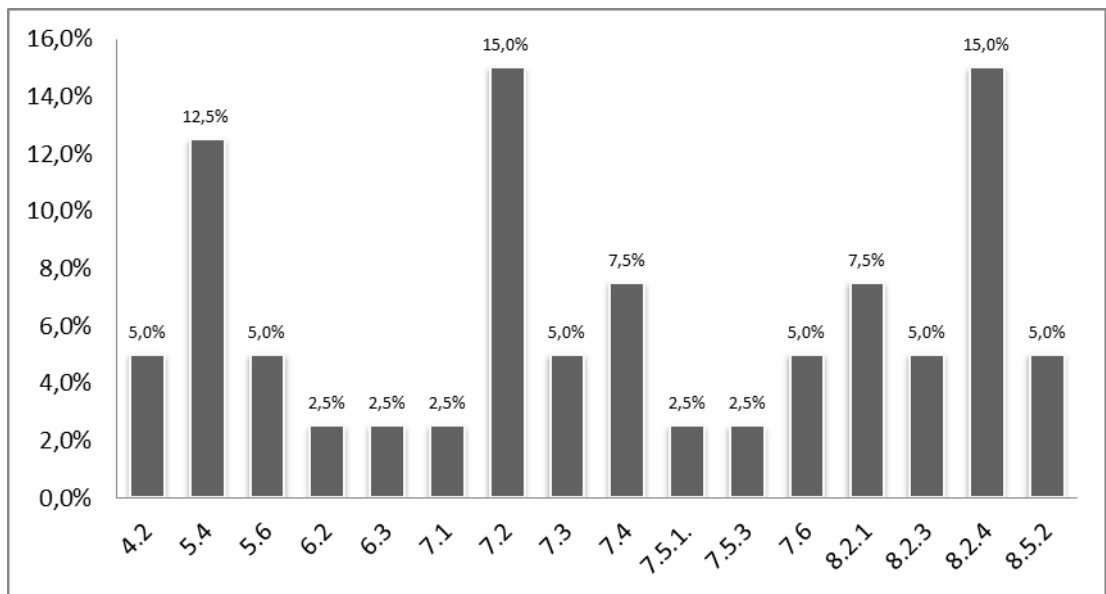


Figure 4.1: Percentage of non-conformities detected in AENOR's external audits reports.

8.2.1. Non conformities evaluation.

As the graph below shows, the largest number of deviations has taken place in relation to paragraph 7.2, 8.2.4 and 5.4 of the standard ISO 9001:2008. These standard section contains from 15% to 12,5% of the total non-conformities encountered of the entire sample. Those sections are related to:

- 7.2 'Customer- related processes.
- 8.2.4 'Monitoring and measurement of product'
- 5.4 'Planning'

Therefore, the main reasons for the appearance of each one of the non-conformities are detailed and exposed in the following section.

7.2. Customer- related processes – 15%

It is one of the standard's sections with collects more deviations from the evaluated sample. According to ISO 9001:2008 the organization must determine



any requirement specified by the client and those not stated by the customer but necessary for a specified use.

The majority of the reported non-conformities are based on the following statements:

- There is no evidence of compliance according to the technical requirements specified in the project such as, fire resistance of slabs, justification for the change of concrete use and lack of approval by the construction managers.
- Does not include the description of the selection processes as well as database management studies, explicitly required by the standard in section 7.2.2, 'Records of the results of the review and actions arising from the review shall be (section 7.2.2, ISO 9001:2008)

8.2.4. 'Monitoring and measurement of product' – **15%**

In the event of those organizations whose business is mainly construction works, this requirement has been developed mainly from inspections points and testing plans.

The biggest difficulty detected on the adaptation of quality plans in construction organizations is based on the singularity feature of each project which is characterized by unique requirements.

On the other hand, there are also detectable errors in the measuring and monitoring of testing plans.

5.4. 'Planning' – **12.5%**

Up to now, the construction field has been able to identify targets for improving global management systems; even so, it is difficult to define measurable targets for construction processes development.

The temporal character of most of the construction activities complicates the identification of improvement opportunities which could be applicable to new contracts.

Some difficulties are found in defining improvement actions in organizations which just want to maintain the currently existing results. Nowadays, most of the construction companies try to avoid bankruptcy and have tight budget goal-oriented to the principle of continuous improvement established by ISO 9001:2008.

In the same way, it is difficult to ensure Quality Management integrity in those organizations which implement unplanned changes.

7.4. 'Purchasing' – **7.5%**



Although this standard section has improved over the last fifteen years since the quality implementation systems has started, faults and errors are detected in purchasing information between construction entities.

Even though, the organizations have established methodologies for selecting, monitoring and re-assessment suppliers and products, in general, there is no evidence of process-based improvement.

In addition to 'purchasing' standard section, non-conformities are found in relation to the verification of purchased product. Standard requirements are not fulfilled due to deficiencies in its development and implementation.

8.2.1. 'Customer satisfaction' – **7.5%**

Regarding to this standard section, it can be seen a non-compliance increase compared to previous years.

Organizations do not correctly follow information concerning client perception and consequently do not fulfill standard requirements. Construction companies do not determined methods in their management systems so, such information is not used.

As ISO 9001:2008 sets in section 8.2.1 'Monitoring customer perception can include obtaining input from sources such as customer satisfaction surveys, customer data on delivered product quality etc...'

4.2. Document requirements – **5%**.

The number of deviations detected against this requirement, is usually higher in those organization that have recently implemented management systems that those organizations which have more mature and verified system.

It is also common that after deeper organizational changes, associated documentation not always reflect that evolution, which causes the appearance of non-compliance with this requirement.

Small and medium- sized organizations, which have fulfilled documentation requirements and have implemented documented procedures, have successfully met great changes and challenges.

In recent years, it was observed a reduction in the number of deviations from this section of the standard.

Management systems have become more flexible. It is common to find organizations that set goals for improvement and optimize documentation management systems by using new computer- based tools.



This section of the standard usually entails some difficulties for small and medium sized organizations. Non conformities are mostly encountered in the beginning of management systems implementation.

The main non-conformities found related to this section of the standard are based on:

- Organizations do not identify all key processes which means lose control in most of their production systems
- Organizations do not control possible changes in the distribution chain as well as record those changes.

In terms of site works, the main weakness is found when it is necessary to develop an integrated management system of documentation within a corporate environment. Site documentation covers: drawings, sketches, modifications, technical specifications given to suppliers, among others.

Any organization should establish a well-done quality policy during their quality management system implementation. Otherwise, organizations seldom, if ever, have drawn up a police which presents an evolution in content and commitment.

It is common to see how organizations usually implement integrate management systems. Nevertheless, they facilitate more detailed definition in Health and Safety or Environment policies than in terms of Quality.

7.6. 'Control of monitoring and measuring equipment' – 5%

Non- conformities registered on this section of the standard are mostly based on:

- Non- availability of proper calibration or/and test equipment verification.
- Improper control of monitoring and measuring equipment

As ISO 9001:2008 sets in section 7.6 'The organization shall determine the monitoring and measurement to be undertaken and the monitoring and measuring equipment needed to provide evidence of conformity of product to determined requirements'.

As can be seen in the description done above, there are other standard sections that have not been reflected. It does not mean that there are not important, it was only evaluated those sections remarkable due to non-conformities appearance



9. AENOR's report

At this stage, it was carried out a further evaluation of the non-conformity appearance in external audit records. As it was previously described, the main goal was to identify trends and changes suffered by the construction sector in the past few years in terms of non-conformities appearance.

Consequently, the own sample evaluation described above was compared to the collected data exposed by AENOR in its report dated in 2006 about the construction sector.

The construction sector's report provided an overview of the industry's situation in relation to standardization and certification activities. It included data analysis from different construction agents such as: construction companies, developers, engineering and architectural studies, building manufactures, laboratories and quarries, among others.

The analysis of audits records conducted by AENOR provided useful information for construction sector in terms of how to develop, implement, improve and upgrade organizations' quality management systems.

9.1. Output results.

In order to make a better comparison of the results, the following section describes the results recorded by AENOR throughout the report.

It must be noted before starting the presentation of these results that there are differences between the two analyzed samples.

While AENOR's report analyzed all sizes-categories of construction companies (large construction companies and even engineering offices), the study previously carried through was only focus on medium-sized companies results (10 – 499 employees).

Moreover, another discrepancy between both samples can be seen in relation with the total sample size. Most of the differences obtained between the results from both analyses may be caused by the number of reports evaluated.

Consequently, the main goal of this comparison is to identify non-conformities trends, causes and give preventive measures.

The table below shows the non-conformities rates regarding to the standard ISO 9001:2000, valid in 2006. Currently this International standard has been updated to ISO 9001:2008, now in force, having previously evaluated the correspondence between both standards.



Standard Section details	Standard Section ISO 9001: 2008	% appearance
General requirements	4.1	1,00%
Documentation requirements	4.2	8,00%
Management commitment	5.1	0,00%
Customer focus	5.2	0,00%
Quality policy	5.3	0,40%
Planning	5.4	6,80%
Responsibility, authority and communication	5.5	1,90%
Management review	5.6	6,10%
Resource management	6.1	0,40%
Human resources	6.2	5,70%
Infrastructure	6.3	2,30%
Work environment	6.4	0,00%
Product realization	7.1	2,30%
Planning of product realization	7.2	3,40%
Design and development	7.3	2,30%
Purchasing	7.4	8,00%
Control of production and service provision	7.5.1	4,20%
Validation of processes for production and service provision.	7.5.2	1,10%
Identification and traceability	7.5.3	2,30%
Customer property	7.5.4	0,00%
Preservation of product	7.5.5	1,50%
Control of monitoring and measuring equipment	7.6	7,20%
General	8.1	0,40%
Customer satisfaction	8.2.1	2,70%
Internal audit	8.2.2	5,70%
Monitoring and measurement of process	8.2.3	6,10%
Monitoring and measurement of product	8.2.4	6,40%
Control del nonconforming product	8.3	4,20%
Analysis of data	8.4	1,90%
Continual improvement	8.5.1	1,10%
Corrective action	8.5.2	4,50%
Preventive action	8.5.3	0,00%

Table 4.3: Non-conformities appearance, Aenor's report 2006 (Aenor, 2006)



As the sample shows and if it is considered the standard sections with non-conformities rates equal or more that 6%, the most representative section values would be:

- 4.2 'Documentation requirements'
- 5.4 'Planning'
- 5.6 'Management review'
- 7.4 'Purchasing'
- 7.6 'Control of monitoring and measuring equipment'
- 8.2.3 'Monitoring and measurement of process'
- 8.2.4 'Monitoring and measurement of product'

The sum of all these standard section represents around 48,6% of all non-conformities detected through the external audits record evaluated.

The following chart shows the percentage of non-conformities detected by AENOR through its audit records in the construction sector.

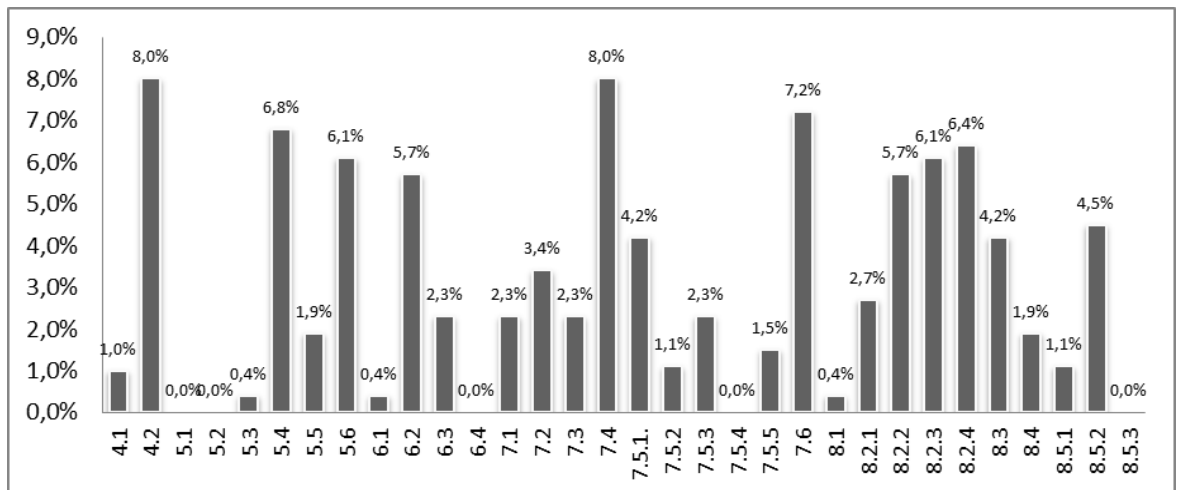
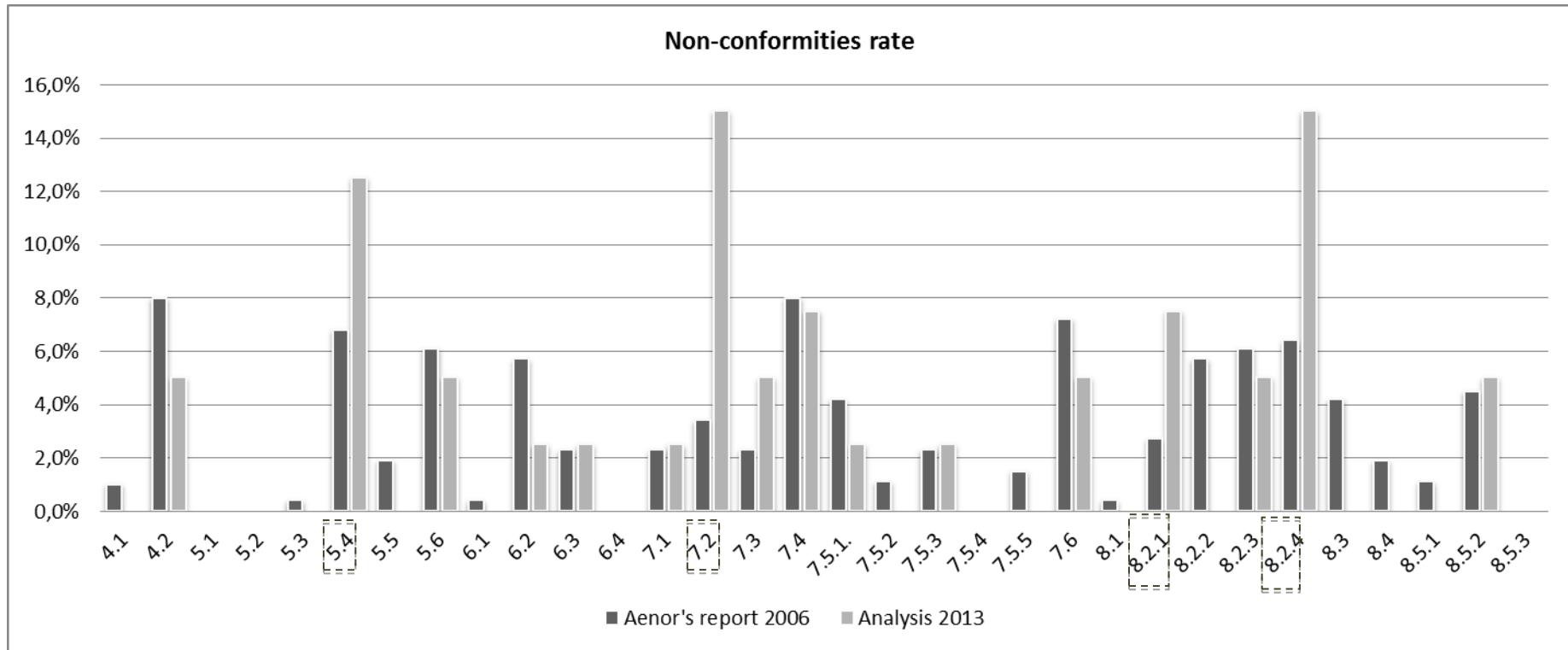


Figure 4.2: Percentage of non-conformities detected in audits conducted by AENOR on the construction industry under ISO 9001:2000.

9.2. Comparison and differences.

In order to observe graphically the difference between the results of both studies, the bars graph below describes their own non-conformities appearance.




 Variation higher than 5% (2013-2006)

Figure 4.3: Percentage of non-conformities detected in audits conducted by AENOR on the construction industry under ISO 9001:2008.



It is worth mentioning from the graph discussed above that the greatest variation in the non-conformities appearance (over 5%) can be seen in the following standard sections:

- 5.4 'Planning'
- 7.2 'Customer-related processes'
- 8.2.2. 'Internal audit'
- 8.2.4 'Monitoring and measurement'

These sections agree with most of the common standard deviations encountered in the study dated in 2013.

It should be taken into consideration as it was previously mentioned that there is a difference between the two samples analyzed. Consequently, the comparison cannot be considered in detail and have been only used to identify trends and forecasts in order to propose corrective measures to be taken by construction companies.

10. Summary and conclusion

As can be observed from the aforementioned analysis, there is a large increase in the number of deviations found in relation to unfulfilment of client requirements as well as breach of monitoring and measurement of construction products.

While the number of non-conformities found related to documentation requirement has decreased from previous years, the current sample shown major problems in standard sections as 'product realization' and 'measurement, analysis and improvement'.

At the end of the last decade and as it was recorded from meeting with Aenor's personnel, the most frequent non-conformities were given in the following standard's sections:

- 4.2 'Documents requirements'
- 7.4 'Purchasing'

In spite of this, in recent years and due to the current economic and social period, it was observed an increase of the number of deviations in particular standard paragraphs. Most of the non-conformities are related to the breach of the objectives set by the company in its quality policy definition. In other words, organizations do not carry out pre-diagnosed quality statements.

Furthermore, non-compliance encountered in relation to customer-related processes (7.2) and customer satisfaction with the final product (8.2.1) can be caused by multiple causes.



One of the possible reasons of the growth of those non-conformities may be due to the recession period that especially construction industry is suffering today.

To sum up as a result of the analysis evaluated it can be stated how construction sector is moving away from the client satisfaction due to incomplete client's orders as well as quality lose owing to undone tests and products which not satisfy standard requirements.

11. Strengths and weaknesses on the construction sector.

As a result of the analysis performed and all the documentation reviewed, it can be summarize the strengths and weaknesses of quality management system implantation within the construction sector.

Strengths

- High staff involvement during the implementation of quality management systems.
- Highest Integrated Management systems implementation.
- The level of implementation of document procedures which reduce no conformities according to section 4.2, ISO 9001:2008.

Broadly speaking, it can be considered the staff-involvement as one of the key factors to successfully implement a quality management system. In those organization in which much of the staff have to directly interact with customers in the realization of their tasks, the relevance of their involvement increases significantly.

In this context, any service provided by a member of the organization that does not meet customer needs may affect the whole systems, however the systems was well established at the first moment.

Weaknesses

Nevertheless, it is also common to observe several weaknesses or possible further improvements in terms of quality management systems. Most of the non-conformities encountered throughout all the audited organizations were caused by the lack of experience in the implementation of some requirements gathered by the standard ISO 9001:2008, such monitoring and measuring processes.

Regarding to the most common areas of improvement, some of the construction sector weaknesses are based on:

- Monitoring and measuring processes which are not directly oriented to those which provide a specific service.
- Avoid redundancy or duplication of the information contained in more than one document.



- Increase the effectiveness of those methods used to monitor the services which affect the scope of the system
- Organizations do not meet customer requirements.

Certainly, an important aspect to improve in many organizations is to avoid redundancy of information: the more times you repeat the same information, the highest probability of having a human error in the capture or data transcription.

Another thing to improve would be the methodology defined for tracking or monitoring the services provided. Too subjective definitions may involve some laxity in those applications.

It should not be forgotten that organizations must meet customer requirements and look for customer satisfaction, which should be one of the main goals of a Quality Management system implementation.



CHAPTER 5.

12. Approach to enhance quality on construction sector.

After analyzing all the positive and negative points acquired by construction companies when implementing a quality management system, it is necessary to expose how these organization can improve efficiency as well as its strategy against the market.

12.1. Quality manual and systems procedures

On the one hand, and in connection with each one of the standards sections associated with nonconformities, it is needed to point out which documentary structure and system requirements are applied on each section.

To this end, it is essential to emphasize the good **quality manual** processing.

Its structure is shown below but some annexes can be seen in detail in the APPENDIX C, D, E, F.

A quality manual must include the following sections (Garrido & Montero, 2008)

- Manual scope.
- Quality Management systems requirements
- Annexes to the manual
 - o Appendix 1: Diagram process, see APPENDIX C
 - o Appendix 2: Responsibilities' chart, see APPENDIX D
 - o Appendix 3: Organizational chart, see APPENDIX E
 - o Appendix 4: Document structure and system requirements, see APPENDIX F
- System Procedures
 - o PS 001: Review and system planning.
 - o PS 002: Customer relations.
 - o PS 003: Documentation and records control.
 - o PS 004: Relationship with suppliers.
 - o PS 005: Identification and encryption papers.
 - o PS 006: Non-conformities control
 - o PS 007: Corrective and preventive actions.
 - o PS 008: Training
 - o PS 009: Process control
 - o PS 010: Inspection
 - o PS 011: Constrolling inspection teams, measuring and testing
 - o PS 012: Internal quality audits.
- Operating procedures
 - o PO-IT 001: Writing Health and Safety records.
 - o PO-IT 002: Health and Safety Coordination.
 - o PO-IT 003: Management of work execution.



- PO-IT 004: Measurements
- PO-IT 005: Completion of works.
- PO-IT 006: Competence activities
- PO-IT 007: Support
- PO-IT 008: Orders.
- PO-IT 009: Orders responsibility.
- PO-IT O10: Controlled copies treatment
- Instructions for use.

In particular, organizations must place special emphasis on those standard sections which have associated more non-conformities.

Even it is shown in the APPENDIX F, the following table shows which procedures must be reviewed and improved in order to eliminate the consequences caused by non-conformities.

STANDARD Section	Requirement	RECORDS Procedures
7.2	Customer-related processes.	PS002/ Customer relation
8.2.4	Monitoring and measurement.	PS001/ Review and system planning. PS012/ Internal quality audits. PS009/ Process control. PS010/ Inspection.
5.4	Planning	PS001/ Review and system planning.
7.4	Purchasing	PS004/ Relationship with suppliers.
8.2.1	Customer satisfaction	PS001/Review and system planning. PS012/ Internal quality audits. PS009/ Process control. PS010/ Inspection.

Table 5.1: Quality system procedures associated with non-conformities analysis.

As it can be seen, each section of the standard is associated with one or more procedures. The former must be reviewed and improved if any non-compliance is found.

The most relevant procedures due to the external audit records analysis are described in the following section:

PS 001 'Review and system planning'



This procedure defines the method throughout the top managers of the company reviews the compliance of the Quality Management system implemented. It ensures its effectiveness and continuously suitability, and help company managers to develop planning actions for improving and reaching future quality objectives.

PS 002 'Customer relation'

The procedure established by the company should be based on the regulation of customer communication, which sets how the organization should inform the development of the order, queries, changes and amendments thereto.

PS 004 'Relationship with suppliers'

The company should establish procedures to suggest the set requirements to suppliers. They must realize procedures defined by conditions that allow performing services under controlled conditions.

PS 009 'Process Control'

The company must establish checkpoints over the offered products. If the expected results were not achieved, the organization would proceed to carry out corrective actions which ensure process compliance.

PS 010 'Inspection and assessment'

The objective of this procedure is to define the method for the treatment of non-conformities activities carried out by the company.

PS 012 'Internal quality audits'

This procedure established the method that the company must use to perform internal quality audits in order to verify compliance with the requirements of the Quality Management System implemented by the organization.

12.2. Continual improvement

Another key element of success for a Quality Management system implementation is the **continual improvement**. It is set by the ISO 9001:2008 in section 8.5.1 and it is described as 'The organization shall continually improve the effectiveness of the quality management system through the use of the quality policy, quality objectives, audit results, analysis of data, corrective and preventive actions and management review'. In other words, it must be carry out through a creative participate of all the staff always led by the Management.



In general, continual improvement is proposed to prevent organization to adopt paralyzing routines as well as to eliminate error and failures in the services they provide.

The main objectives of continuous improvement are always aimed in two directions:

a) **Oriented processes** are based on optimizing the features and functional and operational parameters by promoting actions such as: benchmarking techniques, assignment of responsibilities and/or stimulating the active participation of improvement actions.

b) **Result- oriented processes** are based on optimizing and improving indices and figures of their results, by applying some techniques such as:

- Reducing costs.
- Minimizing waiting times and process step
- Increasing the productivity, efficiency and effectiveness of the products and services.
- Maintaining and increasing the quality of products and services.

The entire organization should take an important role in the processes improvement by adopting certain activities.

a) The **directors** are tasked to complete the following actions:

- Find information about problems and incidents.
- Involve the different areas implicated getting solutions during their implementation.
- Trying to change service companies' mindset. A flexibility attitude is characterized as the basis of continual improvement.
- Perform a leadership role and control support, stimulating and motivating all employees.
- Provide technical support, as well as, necessary resources to fulfill the planned goals.

b) **Employees** must participate:

- Offering all the information about problems, mistakes, failures and incidents to top managers.
- Engaging an active role on improvement plans implementation.
- Suggesting new proposals and suggestions focus on continual improvement.
- Participating and cooperating with different working groups related to site works quality implementation.
- Acting and playing an active role as an integral part of Improvement Groups.



12.2.1. Methodology

As much of the existing literature on the subject collects, continual improvement in construction industry is based on a methodology characterized by the following features:

- Process problem definition and improvement goal definition.
- Collection and analysis of available data in addition to analysis of the most frequent problems.
- Identification and determination of root causes.
- Identification of solutions and alternatives, always prioritizing preventive solutions.
- Confirmation that the problem and its causes have been eliminated. Verification that all the improvement's goals have been achieved.
- Evaluation of the effectiveness and efficiency of the continuous Improvement Plan.

As far as it is concerned, to implement continuous improvement plans there are multiple methods whose efficiency and features have been demonstrated by the practice in many organizations.

All methodologies have a common standard based on enhancing teamwork over individual work as well as developing leadership in the organization. None of those methods are exclusive so could be chosen depending on the characteristics of the organization.

The following section briefly defined all of them, as well as, how can be adapted to the construction sector.

A way to facilitate the choice of method is establishing a matrix which allows organizations to see at a first glance all the aspects on which every method depends:

		Stages						
		Identification	Data Analysis	Causes	Solutions	Eliminations of the causes	Implantation	Evaluation
Methods	5S Methodology	✓	✓				✓	✓
	Total Productive Maintenance	✓	✓				✓	✓
	Suggestion Scheme			✓	✓	✓		✓
	SWOT Analysis	✓		✓	✓			
	Quality Circles	✓	✓	✓	✓			
	Nominal Group Techniques	✓		✓	✓			✓
	Brainstorming	✓	✓		✓		✓	✓
	Bechmarking			✓	✓		✓	
	Force field analysis	✓	✓		✓		✓	✓

Figure 5.1: Continual improvement Methods' Matrix
Source: Garrido, A., Montero, E., 2008 p.71



12.2.2. Continual improvement evaluation

Regarding to the continual improvement evaluation, this section includes a briefly outline of each one of the methods previously shown in the matrix.

i. 5S Methodology

This technique is grounded on maintaining a work environment neat, clean and well organized. It is native from Japan and consists on five phases called: Seiri, Seiton, Seiso, Seiketsu and Shitsuke (QMAC Management consultants)

a) Organization

It is based on identifying and separating the necessary materials and getting rid of those which are unnecessary.

In the construction sector, daily business documents are generated such as: reports, books, advertisements or other technical projects. Therefore it is necessary to identify and properly classify all the documentation necessary for the proper work performance. That is to say, continuously updating files and removing useless documents.

b) Order

Establish codes or classification systems and archiving documents that are typically used in order to allow easy location.

c) Cleaning

It must be identify and eliminate those sources of contamination, ensuring that all means are in perfect conditions.

Especially in site works, it is completely necessary to identify sources of contamination as well as to maintain files, computers and other materials under the right conditions.

d) Visual control

Visual inspection is defined as the action to easily distinguish normal situation from another abnormal, by simple rules and visible to everyone.

e) Discipline and habit

The entire organization must work permanently in accordance with current standards.

The aim is to improve working and safety conditions, as well as, working environment, staff motivation and effectiveness and efficiency in the organization by increasing productivity and competitiveness.

The key findings are:



- More employees' engagement owing to the understanding that continuous improvement is an activity that affects everyone and it is a team effort.
- As a result, organizations get a higher production rate, resulting in fewer defects, damage and accidents.

ii. Total Productive Maintenance (TPM)

It is based on the performance of preventive maintenance rather than corrective and decentralized (Habib & Wang, 2008)

Therefore, preventive measures are established in order to anticipate potential problems thus preventing these ones from occurring. Knowledge and skills of all members of the team must be known, either through personal interviews periodically group meetings. Ongoing training strategies should be a part of this method.

iii. Suggestion Scheme

Setting up a suggestion scheme allows the organization to define the continual improvement objectives based on the following elements:

- The delivery of rewards which were proportional to the proposed improvements made.
- Creating valuation committees that must have a heterogeneous composition of all organization areas.
- There must be some conditions and requirements of the proposed development plan.
- The company must use all means and resources in order to implement the best suggestion previously selected.
- Incentives should be proportional to the quality of selected suggestions.
- The suggestion, put into practice, should be planned and evaluated based on the expected results.
- The entire organization must participate and get in their scope.

iv. SWOT Analysis

SWOT is compound of the four first letters of the following words:

- S= Strengths
- W= Weaknesses
- O= Opportunities
- T= Threats

This technique collects the services and product diagnosis, showing the factors which facilitates or restricts the continual improvement plan of the organization.



Displaying and sorting by priority all these factors, the organization can make conclusions and perform a better Improvement Plan.

The conducted method analyses the positive and negative factors in relation to the Improvement Plan execution, as well as, allows organizations to maximize and minimize each one of these factors.

A typical organization might performed the SWOT analysis described below.

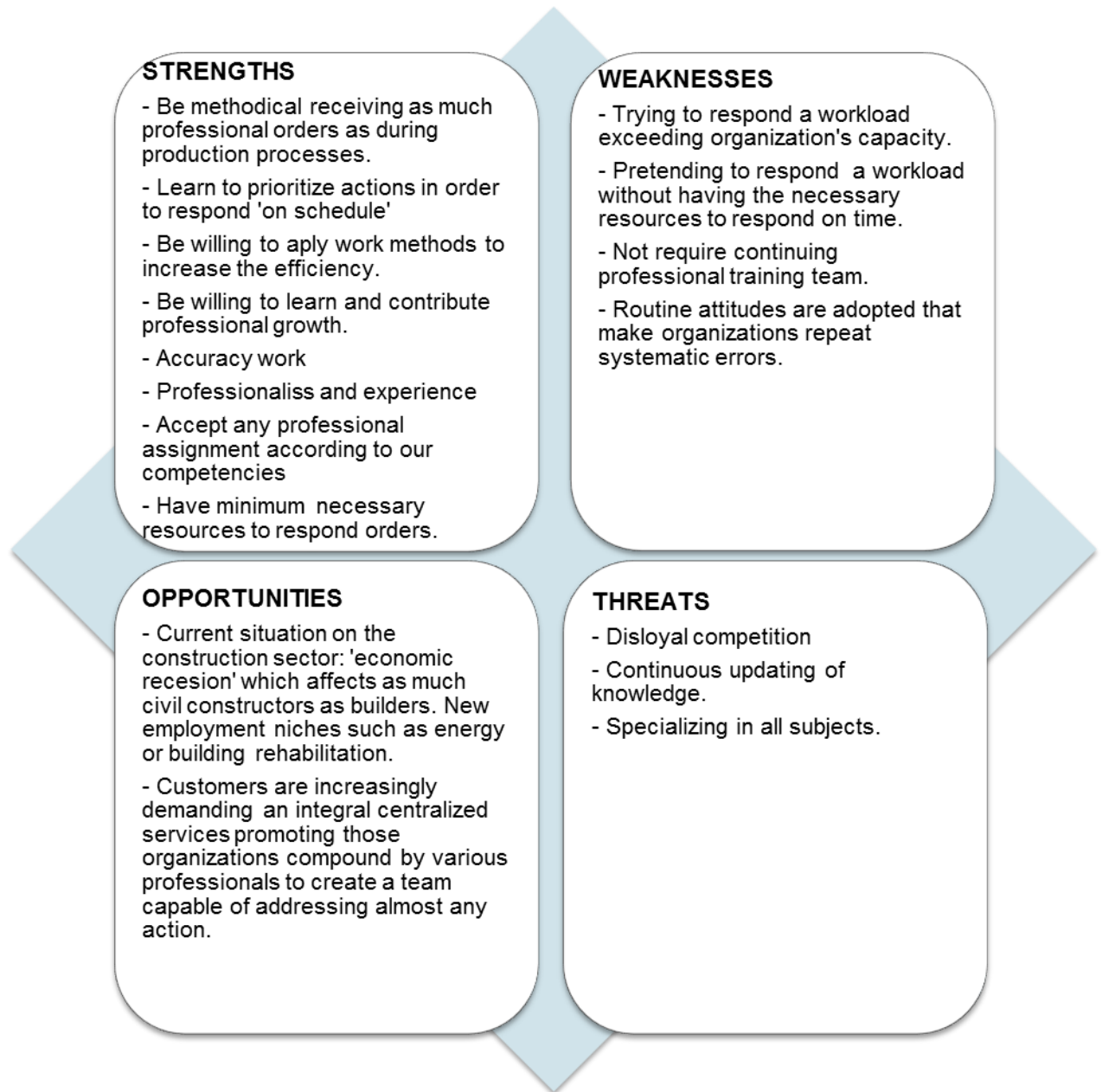


Figure 5.2: SWOT analysis performed by a currently construction company (Garrido & Montero, 2008)



v. Nominal Group Techniques

This technique try to give an equal opportunity to all group members to presents its views about problems which are under discussion (Tague, 2004).

This method looks like a democracy. Problems are presented and numerically evaluated numerically, assigning priorities and acting on them.

vi. Brainstorming

It is a method based on the generation of the maximum number of ideas in the shortest possible time. It is advisable to use when lots of ideas or solutions are needed in order to find the maximum reasonable solutions characterized by its creativity or innovation.

It is possible to use it in two different ways:

- a) **In order.** There is an order of participation in the group. Each member gives his idea when it is his/her turn
- b) **No order.** In this case, the members of the group present their ideas without special order of participation. Can easily lead to excessive participation of those who are more open.

vii. Bechmarking

Benchmarking is defined as the search for best practices of other companies, departments or professional practices in order to improve their own organizational performance. That is to say, copy other best practices that an organization can subsequently improve.

The main objectives to be achieved are:

- Learn from other companies or departments that are the subject of benchmarking.
- Adapt the best practices.
- Continuous improvement of the already established practice.

There are considered diferent types of comparative analysis:

- Internal Comparative Analysis.

It is based on the analysis of the activities and processes within the organization itself. A comparison is made between different departments, different locations or branches within the same busines group.

- External Comparative Analysis



It is considered as the comparison of practices with direct competitors. The phases of a comparative analysis process are shown in the table below.

Phases	Activities
1 st Planning	Which process is going to be improved?
2 ^{sd} Data collection	Which department or organization we can compare to?
3 ^o Analysis	It comes to learning by comparison with the competition.
4 ^o Transformation	It is based on the development of action plans and implementation procedures of the necessary changes.

Table 5.2: Phase sequence of an external comparative analysis process.
Source: Garrido, A., Montero, E., 2008 p.78

There are some conditions that must be considered in order to have a positive benchmarking outcome.

- Benchmarking requires knowledge in Management Systems. It is necessary to analyze, understand and define own organization internal processes.
- Quantitative indicators are an essential part of benchmarking.
- Through the indicators or/and quality objectives, it is evaluated and compared the level of effectiveness of:
 - o Organization's practice
 - o Competitor's practice.

viii. Force field analysis

It is a method for discovering the forces that help or slow down changes. This technique should be used for situations where it is necessary to determine the forces for or against a change, assessing and weighting the degree of difficulty or facility to the change.

Once, difficulties and facilities are known, it is easier to counteract negative effects. The conditions and phases that must be met on a force field analysis are (Thomas, 1985)

- Identification and determination of changes planned to be made.
- Description of those elements considered as 'favorable'. Actually those activities that will support the changes.



- Description of those elements considered as 'unfavorable'. Actually those activities that go against the changes.
- Analyze each of the forces in order to turn them in favor of change ensuring that no negative consequences occur. It is always easier to reduce unfavorable forces than increase positive forces.

Favorable forces	Unfavorable forces
Motivation	Reduced time to do the job
Staff's qualification	Uncoordinated orders
Procedures.	Out of control changes

Table 5.3: Example of a Force Field Analysis

In the case of unfavorable forces exceed favorable forces, there will easily be no possibility of change. However it seems clear that if the forces are stronger favorable, the change will occur towards the modernization of production processes. This system raises the possibility of external collaboration, facing the organization final scope.

ix. Quality cost.

This is an important improvement tool. Basically there are four quality costs:

- Prevention costs (quality system implementation and maintenance)
- Control costs
- Internal failure costs (before delivery to the customer)
- External failure costs (after delivery to the customer)

This tool check if quality investment budget returns as lower costs than correcting faults costs or intangibles costs such as the company's prestige.

Once, one or more methods will be carried out, it must be evaluated the implementation as well as the positive tested changes.

An objective and practical evaluation system is based on performing a set of questions that can be assessed from 1 to 5 (5= excellent; 1=very poor)

Nº	Ev
1	Do groups include employees at all levels of the organization?
2	Are the suggestions and ideas for improvement applied quickly?
3	Are the potential savings of the improvements analyzed and determined?
4	Are the plans for improvement made for all organization's departments?
5	Is Management actively involved in the actions and improvement plans?
6	Are the results achieved by the improvement projects publicly known?
7	How organization use the corrective actions during the problem evaluation?
8	How Management direction use preventive actions to avoid losses?



9	Does Management ensure the systematic use of methods and tools for continuous improvement?	
10	Do organizations contribute continual improvement standarization?	
	Total sum of points	xx
	They are considered acceptable values above 35 points	

Table 5.4: Quality cost evaluation system
Source: Garrido, A., Montero, E., 2008 p.81

12.2.3. Attitudes and values

Apart from all the methods explained above and in order to improve an organization quality system it is completely necessary to fulfill a list of values, attitudes and personal abilities needed in every organization:

All staff member must possess these values:

- Ability to deal with any situation.
- Ability to observe
- Good physical conditions to exercise the proffesion and do not stop reviewing the work.
- Intuition
- Ability to search for information
- Organizational capacity
- Ability to delegate
- Organizational capacity
- Resistance to fatigue
- Be meticulous and careful developing the work.
- Honesty
- Common sense
- Possess character, when it is required.
- Honesty
- Listening
- Ability to internal criticism
- Ability to work
- Reflective
- Ability to adapt to new technologies
- Ability to analyze
- Empathy
- Commercial capacity
- Ability to disconnect
- Formality
- Ability to motivate others (subordinates) and/or partners.
- Availability time and geography.

These qualities must be accompanied by knowledge acquired by the company in order to continuously improve.



- Knowledge associated with new technologies such as participating in forums, blogs, and databases owing to be able to provide the required information in an easy way.
- Knowledge of mandatory regulations.
- Feedback for continuous regulations.
- Expanded knowledge about a particular field.
- Perform graduate courses related to professional activities.
- Knowledge of all work's job to lead an execution.
- Complementary knowledge on economic management.
- Legal knowledge complementary to regular exercise.
- Urban knowledge in some cases.
- Perform additional seminars.
- Knowledge of prevention of occupational risks
- Knowledge of traditional building systems.
- Knowledge of innovative building systems.
- Knowledge of quality systems (for self-corrections, traceability...)

All these skills can be acquired through continuing training.



CHAPTER 6

13. Conclusion

The construction sector is considered as one of the engines of National and European economy as well as an unique sector which has many differences compared to other currently economic sectors.

As a conclusion to the study performed, it can be extracted how even having spent more that ten years since the first quality system implementation on construction companies, today these systems have still had inconsistencies and failures.

The occurrence of non-conformities have a direct impact on the competitiveness of the companies and it can be considered as an essential goal nowadays. Due to the current economic situation, construction sector has one of the largest economic degrowth, approximately 3% on the euro-zone as a whole.

At present, it has been observed that most of the non-conformities are related to non-compliance with customer's requirements as well as on monitoring and measurement of products.

In this context and being compared with studies performed almost five years ago it can be seen a reduction of the number of non-conformities in relation to document management failures as well as deficiencies on the purchasing department.

It is essential to develop a preventive plan that leads construction companies, on setting up quality systems procedures and avoiding as much as possible, the appearance of these non-conformities.

As it is extracted from the analysed study, organizations do develop a good quality manual and do not reduce the budget devote to continuous improvement plans.

Implement a continuous improvement plan allows companies to optimize their product processes avoiding paralyzing routines which lead them to commit errors in their production processes.

All company employees must be aware of their role in the organization. They must develop values and attitudes that facilitate the whole enterprise to get a better performance walking hand in hand with the standard ISO 9001:2008.



14. Further research.

As it has been previously discussed, this research has been focused only on medium sized enterprises within the construction sector. As a matter of the fact, these companies have been forced to reduce their budgets earmarked for maintaining quality management systems and thus avoid bankruptcy.

This study gives a broad overview of the current situation on the sector and gives guidance about which non-conformities are the most common in present times. The research is followed by the identification of currently trends on the non-conformance appearance and finally corrective and preventive measures are exposed.

Because of being out of scope for the development of this thesis, no specific measures have been included and oriented for an specific construction subsector. Meetings with experience technical personnel, customize studies and in situ observation of processes performance by construction organizations would make it possible to define specific measures that whould allow these companies to improve their adaptation to ISO 9001:2008.

As it was indicated during the research study, one of the most practise methods in order to improve quality systems performance is conducted by benchmarking techniques. The former is defined as a competitiveness study which allows organizations to observe which is its situation on the market and thus act as promoter of preventive and corrective processes that keep them from standard failures.

To sum up, the construction sector should make an effort to meet Quality standards' requirements. Once, they were achieved, great add value would be provided to their products. Construction organization would achieve full customer satisfaction and why not, be competitive and efficient in the market.



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APPENDIX A: 'Non- conformity table' - Scheme

EXP: xxx

___ / ___ / ___ / ___

___ / ___ / ___ / ___

EXP: xxx

Nº of Report

Nº of Report

EXP: xxx

Nº of Report ___

Non-conformities table

N.C. Ref	Non- conformity description.	Standard section (ISO 9001)	N.C category.
01	In the civil work xxx and for the metallic structure shipment, do not have the quality certification for HEB-240 pillars of the basement floor.	8.2.4	Minor
02			Major

The Manager of the Organization

The Audit team

Note 1: The organization should have to establish and document corrective actions for all the non-conformities described in the table.

Note 2: Although there may be sections/ subsections that are audited together, the non-conformity is assigned to the specific sub-section in which are detected.

**APPENDIX B: 'Non- conformity table' – Analysis 2013 - Example**

The table shows below an example of one of the **sixteen** external audit report evaluated on the non-conformities analysis. In order to maintain confidentiality it was obviated any feature that can be associated with any certified entity.

Non-conformities table

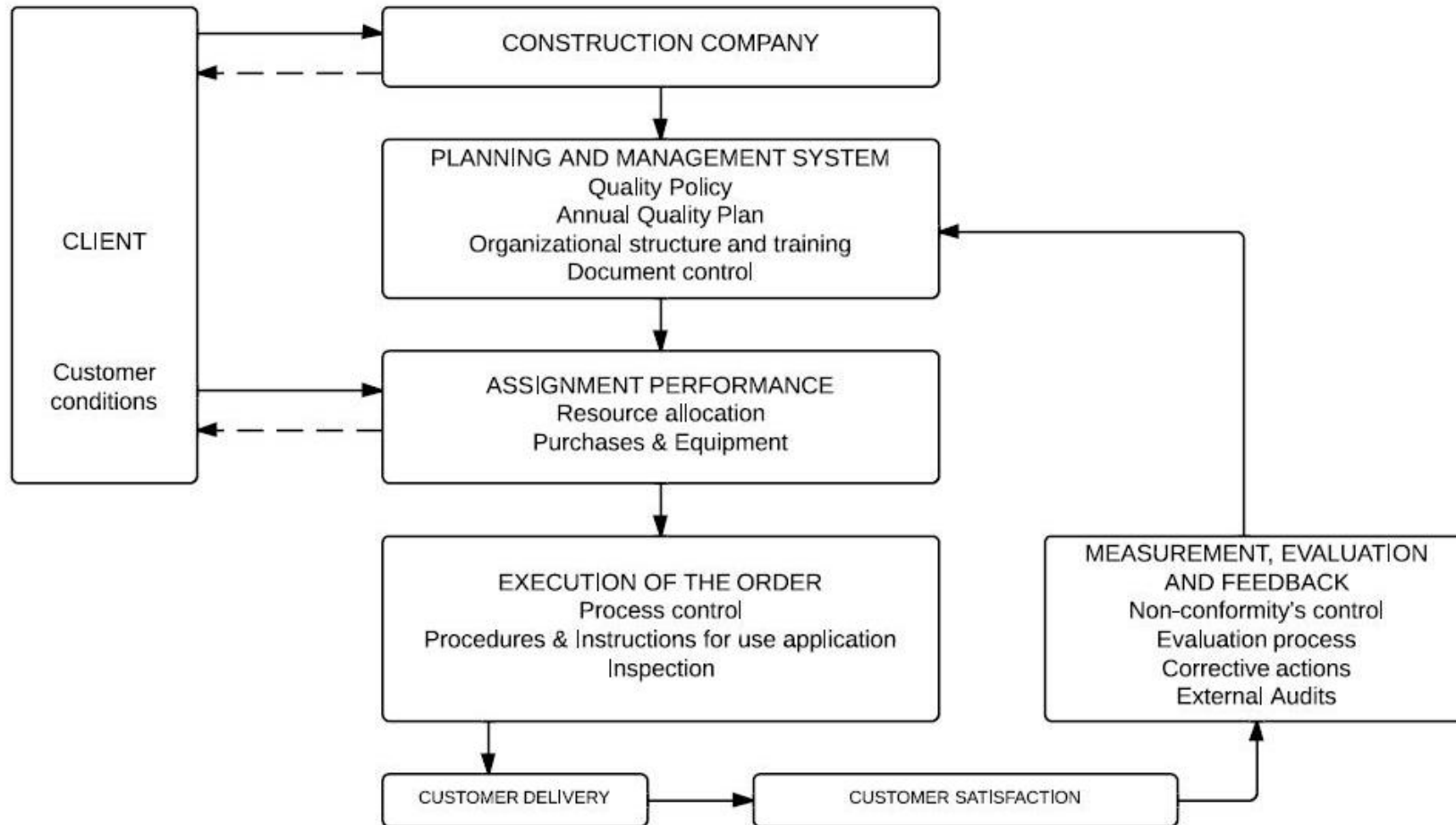
N.C. Ref	Non- conformity description.	Standard section ISO 9001:2008	Standard section ISO 14001:2004	N.C category.
01	No limits for the implementation of the objectives previously proposed: ' 3% Reduced paper work', ' Improving 2% the effectiveness of contracting' as well as 'Increase of managed waste' which is based on meeting requirements	5.4	4.3.3	Minor
02	The top manager's review dated on 2012/11/30 do not collect non-conformities analysis and environmental corrective actions as well as the customers claim status.	5.6	4.6	Minor
03	It is detected how some suppliers/subcontractors are not included in the 'suppliers list' updated on Novembre, 2012, contrary to the procedure describes as P-07 'Demolition...'	7.4		Minor

The Manager of the Organization

The Audit team



APPENDIX C: 'Diagram process'





APPENDIX D: 'Responsibilities chart'

ACTIVITIES		Standard requirements	RESPONSABILITIES			
Nº	Description		Management	Quality	Production	Resources
1	Control of documents and records	4		R	I	I
2	Quality policy; Organization; System reviews	5	R	I		
3	Planning of Quality Management System, objectives	5	R	I		
4	Determining customer requirements	5	R		I	
5	Definition of responsibilities and authorities	5	R	I	I	
6	Designation of the Manager	5	R	I		
7	Definition of internal communication processes	5	R	I	I	
8	Periodic review of the Quality system	5	R	I	I	I
9	Determination and allocation of resources	6	R	I	I	
10	Determine the existing competence for the operations	6	R	I	I	
11	Identification of training needs	6	R	I	I	
12	Evaluating training effectiveness	6	R	I	I	
13	Infrastructure and work environment	6	R	I	I	I
14	Determining services specifications	7	R		I	
15	Service planning	7	R		I	
16	Offers, revisions and amendments, contracts and orders	7	R		I	
17	Communication with customers	7	R		I	I
18	Design Master Plan	7	-	-	-	-
19	Evaluation and subcontractors qualification	7	R	I		I
20	Purchasing management / subcontractors	7	R		R	R
21	Verification of purchased products/ subcontracted services	7	R		R	R
22	Verification of the supplied products by customers	7		I	I	R
23	Identification and traceability	7		R	I	
24	Process validation	7	R	I	I	
25	Determination of process controls	7	R	I	I	

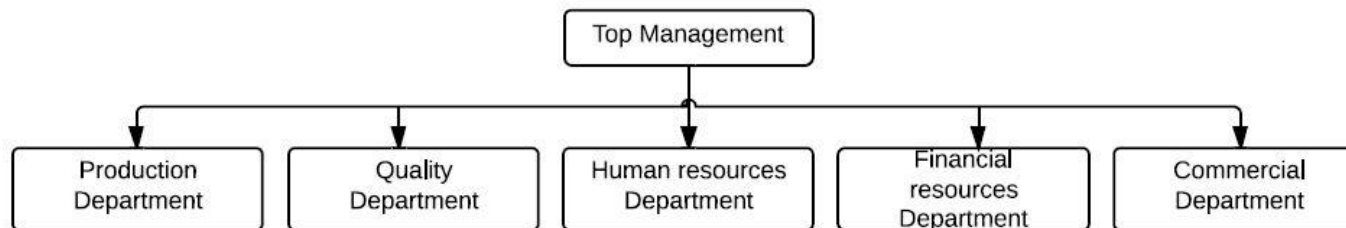


26	Process control	7	R	I	R	
27	Process Equipment maintenance	7	R	I	I	I
28	Product/ service's preservation and delivery	7	I	I	R	I
29	Measurement of customer satisfaction	7/8	R	I	I	
30	Definition of control and inspection criteria	8	R	I	I	
31	Inspection of materials and services at the front desk	8			R	R
32	Inspection during the service	8			R	
33	Final inspections	8			R	
34	State of inspection' of products	8		R	I	
35	Control of measuring devices	8		R	I	
36	Control of non-conforming products	8	R	I	R	
37	Transitional arrangements relating non-conformities	8	R		R	
38	Customer notifications of incidents on the goods supplied	7	R		R	
39	Definition of corrective and preventive actions	8	R	R	R	I
40	Approval of corrective and preventive actions	8	R	I	I	
41	Control and maintenance of infrastructures	6	R	I	I	I
42	Internal quality audits	8	R	I		
43	Data Analysis	8	R	I	I	
44	Establishment of improvement actions	8	R	I	I	I

Source: Garrido, A., Montero, E., 2008 p.53

R: Responsible – I: Involved – ‘-’ No application

APPENDIX E: ‘Organizational chart’





APPENDIX F: 'Document structure and system requirements'

STANDARD		Standard requirements	RECORDS	FORMAT & SUPPORT	RECORDS	
Nº	Section		Procedures	Type	Yes/No	
4	QUALITY MANAGEMENT SYSTEMS	4.1 Quality requirements	Quality Manual Appendix 4: Structure and document requirements Appendix 1: Process diagram			
		4.2 Document requirements	PS 003: Documentation and records control.	Records update and distribution of internal documentation	Yes	
		4.2.1 General				
		4.2.2 Quality manual		Records update and distribution of external documentation	Yes	
		4.2.3 Control of documents				
		4.2.4 Control of records	Appendix 4: Structure and document requirements PS 005: Identification and encryption papers. PO-IT O10: Controlled copies treatment	List of quality records	Yes	
				Controlled copies record	Yes	
				Quality Manual PS 001: Review and system planning.	System review report and annual quality plan	Yes
				Quality Manual PS 001: Review and system planning.	System review report and annual quality plan	
				Quality Manual PS 001: Review and system planning.	System review report and annual quality plan	Yes
5	MANAGEMENT RESPONSIBILITY	5.1 Management commitment	Quality Manual PS 001: Review and system planning.	System review report and annual quality plan	Yes	
		5.2 Customer focus	Quality Manual PS 001: Review and system planning.	System review report and annual quality plan		
		5.3 Quality policy	Quality Manual			
		5.4 Planning	PS 001: Review and system planning.	System review report and annual quality plan		
		5.4.1 Quality objectives			Yes	
		5.4.2 Quality management system planning				
		5.5 Responsibility, authority and communication	Quality Manual Appendix 2: Distribution of responsibilities	Professional profiles	Yes	
		5.5.1 Responsibility and authority	Appendix 3: Organization's chart			
5.5.2 Management representative						
5.5.3 Internal communication	PS 008: Training					
5.6 Management review	PS 001: Review and system planning.	System review report and annual	Yes			



	5.6.1	General		quality plan	
	5.6.2	Review input			
	5.6.3	Review output			
6	6.1	Provision of resources	PS 001: Review and system planning.	System review report and annual quality plan	Yes
	6.2	Human resources	PS 008: Training	Professional profiles	Yes
	6.2.1	General		Curriculum vitae	Yes
	6.2.2	Competence, training and awareness		Annual training summary	Yes
	6.3	Infrastructure	PS 001: Review and system planning.	Certificates and other evidences	Yes
				System review report and annual quality plan	Yes
	6.4	Work environment			
7		Planning of product realization			
	7.1	Customer-related processes	PS 009: Process control		
	7.2	Customer-related processes	PS 002: Customer relations.		
	7.2.1	Determination of requirements related to the product			
	7.2.2	Review of requirements related to the product			
	7.2.3	Customer communication			
	7.3	Design and development	Not applicable		
	7.4	Purchasing	PS 004: Relationship with suppliers.	List of orders	Yes
	7.4.1	Purchasing process		Supplier sheet	Yes
	7.4.2	Purchasing information		Homologous suppliers list	Yes
	7.4.3	Verification of purchased product			Yes
	7.5	Production and service provision	PS 005: Identification and encryption papers.	Registration records of test and testing materials	Yes
	7.5.1	Control of production and service provision	Operating procedures	Occupational safety and health plan approval	Yes
	7.5.2	Validation of processes for production and service provision	PO-IT 001: Writing Health and Safety records.	Occupational safety and health coordination report	Yes
	7.5.3	Identification and traceability	PO-IT 002: Health and Safety	Designation of director and project	Yes

Analysis of non- conformities from external audits



	7.5.4	Customer property	Coordination.	manager	
	7.5.5	Preservation of product	PO-IT 003: Management of work execution. PO-IT 004: Measurements PO-IT 005: Completion of works. PO-IT 006: Competence activities PO-IT 007: Support PO-IT 008: Orders. PO-IT 009: Orders responsibility. PO-IT 010: Controlled copies treatment	Controlled copies record Controlled copies modifications Work records Orders and work instruction	Yes Yes Yes Yes
	7.6	Control of monitoring and measuring equipment	PS 011: Constrolling inspection teams, measuring and testing	Manual control of measurement instruments Topographic equipment control Overall equipment sheet Certificates	Yes Yes Yes Yes
8		8.1	General	Quality Manual	System review report
		8.2	Monitoring and measurement	PS 001: Review and system planning.	Annual quality plan
		8.2.1	Customer satisfaction	PS 012: Internal quality audits.	Audit program
		8.2.2	Internal audit	PS 009: Process control	Audit report
		8.2.3	Monitoring and measurement of processes	PS 010: Inspection	Incident report: non-conformities and corrective actions
		8.2.4	Monitoring and measurement of product		Registration process (see 7.5)
		8.3	Control of nonconforming product	PS 006: Non-conformities control	System review report and annual quality plan
		8.4	Analysis of data	PS 001: Review and system planning.	System review report and annual quality plan
		8.5	Improvement	PS 001: Review and system planning.	System review report and annual quality plan
		8.5.1	Continual improvement	PS 007: Corrective and preventive actions.	Incident report: non-conformities and corrective actions
		8.5.2	Corrective action		Preventive action records
		8.5.3	Preventive action		

Source: Garrido, A., Montero, E., 2008 p.54-55

