STUDY ON ENVIRONMENTAL MANAGEMENT SYSTEMS IN CONSTRUCTION COMPANIES

Treball realitzat per:
Eduard Eloy Maurel

Dirigit per:
Manuel Valdés López

Grau en:
Enginyeria de la Construcció

Barcelona, 22 de Maig de 2013

Departament d’Enginyeria de la construcció (EC)
Acknowledgements

The author thanks:

- Ph.D. Manuel Valdés López, as the principal tutor of this study and being a constant source of moral support for the culmination of my professional studies and whose contributions and suggestions will help me to become a professional of this sector.

- Ph.D. Jana Šelih, as the external tutor of this study, for her help with the Slovene language and the elaboration of the questionnaire, as well as for her reviews and suggestions in the development of this thesis.

- Dolores Revuelta Cortés, a 4th year student of English Philology, for her patience and corrections of the English language.

- The Faculty of Civil Engineering of the University of Ljubljana, for letting me use their sources.

- The Chamber of Commerce and Industry of Slovenia (CCIS) for the information provided.

- The construction cluster is gratefully acknowledged for its participation in this study.

- Very specially my parents, for their constant support and patience during all these years as a student, since anything would have been possible without them.
Abstract

Since in 1996 the ISO 14000 standards were published, the construction companies have introduced the Environmental Management Systems (EMS) according to these standards. It has been increasingly recognised that construction activity imposes external costs to the environment. EMS is not only intended to formalize procedures for managing and reducing environmental impacts, but it has also become an important tool for those organizations looking to manage their environmental issues such as pollution prevention, legal compliance, and minimizing the impacts their activities cause to the environment.

Another reference model that companies in the construction sector can use to implement their EMS is the so called Regulation 76/2001 (EMAS), which has been revised and replaced in 2009 and had its entry into force on 11th January 2010. Although this regulation is constantly being updated, today the number of construction companies that support it is still a minority.

The accumulated experience in the application, operation, revision and maintenance of environmental management systems in construction companies, the deficiencies brought to light by the clients and other implied parts, as well as the problems detected during the audits, have constituted a invaluable information source in order to think about the EMS implementation in the construction companies. It should be equally highlighted the part in which the activity of these companies affects the environment directly, that is to say, the building sites. Construction projects and activities are, in general, associated with a wide range of environment impacts. Therefore, the principles of sustainable development should be adopted during construction just like in any other industrial sector.

One of the main aspects of the environmental management in the construction industry is the waste management. Even though these wastes are not excessively polluting, their treatment are problematic since they are generated in enormous volumes.

The aim of this study is not only to review the benefits and major problems in the establishment of ISO 14001 in European construction companies, but also to analyze the implementation of these systems in construction companies, manufacturing companies of building materials and engineering companies.

The implementation of the quality management systems (QMS) in companies of this sector is also included in this analysis. These systems are important for the environmental management form the point of view that it is much easier to implement an EMS if there is already and QMS, especially if they are both standardised according to the ISO 14000 and 9000 series, respectively.
This is a survey of extent of ISO 14001 in the construction industry and a study of environmental management systems. Through the present investigation different construction firms in Europe were surveyed, especially in the Republic of Slovenia, to uncover the hindrance factors contributing to the not adoption of ISO 14001. In the case of Slovenia, and because this country had at its disposal a previous study, it has also been commented the evolution of this implementation in companies of the construction sector since the year 2006.

The paper presents the main features of the EMS standard specification ISO 14001 and environmental management trends in construction sector. It should be pointed out that companies paid especial attention to the development of an EMS, and therefore it can be understood that they are aware of performing civil works taking care of our environment and natural resources. Most construction companies, and especially large companies, consider ISO 14001 as a useful tool.

**Keywords**: environmental management systems, construction companies, ISO 14001, quality, web survey, Europe and Slovenia.
Resumen

Desde que en 1996 los estándares de la ISO 14000 fueran publicados, las empresas de la construcción han introducido los Sistemas de Gestión Medioambiental (SGMA) de acuerdo a dichos estándares. Cada vez más se ha reconocido que la actividad constructora impone costes externos al medio ambiente. Los SGMA no sólo pretenden formalizar los procesos para gestionar y reducir los impactos medioambientales, sino que además se han convertido en una herramienta importante para aquellas organizaciones que buscan manejar sus problemas ambientales, tales como la prevención de la contaminación, el cumplimiento de la ley y la minimización de los impactos que sus actividades causan al medioambiente.

Otro modelo de referencia que las empresas del sector de la construcción pueden utilizar para implementar sus SGMA es el llamado Reglamento 76/2001 (EMAS), el cual ha sido revisado y reemplazado en 2009 y tuvo su entrada en vigor el 11 de enero de 2010. A pesar de que este reglamento está siendo constantemente actualizado, hoy en día el número de empresas constructoras que lo respaldan es aún una minoría.

La experiencia acumulada en la aplicación, operación, revisión y mantenimiento de los sistemas de gestión medioambiental en las empresas constructoras, las deficiencias puestas de manifiesto por los clientes y otras partes implicadas, así como los problemas detectados durante las auditorías han constituido una inestimable fuente de información a la hora de pensar en la implementación de los SGMA en las empresas de la construcción. Debe ser igualmente destacada aquella parte en la que se hace referencia al efecto directo que la actividad de estas empresas tiene en el medioambiente, es decir, en las obras. Por consiguiente, los principios de un desarrollo sostenible deben ser adoptados durante la construcción, al igual que en cualquier otro sector industrial.

Uno de los aspectos principales de la gestión medioambiental en la industria de la construcción es la gestión de residuos. Aún cuando estos residuos no son excesivamente contaminantes, su tratamiento es problemático ya que éstos son generados en grandes cantidades.

El objetivo de este estudio no es sólo revisar los beneficios y problemas a la hora de establecer la ISO 14001 en las empresas constructoras europeas, sino también analizar la implementación de estos sistemas en las empresas constructoras, en las empresas de producción de materiales de obra y en aquellas de ingeniería.

La implementación de los sistemas de gestión de calidad (SGC) en las empresas de este sector también está incluida en este análisis. Estos sistemas son importantes para la gestión medioambiental desde el punto de vista de la facilidad que supone implementar un SGMA si ya
existe un SGC previamente, especialmente si ambos sistemas son estándares de acuerdo a las normas ISO 14000 y 9000, respectivamente.

Este es un estudio de la influencia de la ISO 14001 en la industria de la construcción, así como un estudio de los sistemas de gestión medioambiental. A través de él diferentes empresas constructoras de Europa han sido encuestadas, especialmente en la República de Eslovenia, con el fin de descubrir aquellos factores que contribuyen a la falta de adopción de la ISO 14001. En el caso de Eslovenia, y de acuerdo a un estudio previo existente en este país, también se ha comentado la evolución de dicha implementación en empresas del sector de la construcción desde el año 2006.

En este documento se presentan las principales características de la especificación estándar ISO 14001 para los SGMA, así como las tendencias de gestión medioambiental en el sector de la construcción. Es necesario destacar que las empresas han prestado especial atención al desarrollo de los SGMA, y por tanto se entiende que están concienciadas sobre el desarrollo de las obras cuidando de nuestro entorno y nuestros recursos. La mayoría de las empresas constructoras, y especialmente las grandes firmas, consideran la ISO 14001 como una herramienta importante.

**Palabras clave:** sistemas de gestión medioambiental, empresas constructoras, ISO 14001, calidad, encuesta por web, Europa y Eslovenia.
# INDEX

## 1 INTRODUCTION

## 2 LITERATURE REVIEW

### 2.1 INTRODUCTION

### 2.2 ISO

### 2.3 DEVELOPMENT OF THE ISO 14000 SERIES OF STANDARDS

### 2.4 EMS AND ISO 14001

#### 2.4.1 EMS

#### 2.4.2 ISO 14001

#### 2.4.3 BASIC PRINCIPLES AND METHODOLOGY

#### 2.5 BENEFITS ISO 14001

#### 2.6 ISO 14001 AND EMAS

#### 2.7 ISO 14001 CERTIFICATION OF COMPANIES IN EUROPE; THE CASE OF CONSTRUCTION INDUSTRY

### 2.8 LITERATURE SURVEY

#### 2.8.1 INTRODUCTION

#### 2.8.2 CONSTRUCTION SECTOR AND EMS IMPLEMENTATION

#### 2.9 ISO 9001

## 3 OBJECTIVES

### 3.1 INTRODUCTION

### 3.2 GENERAL OBJECTIVE

### 3.3 DERIVED OBJECTIVES

## 4 METHODOLOGY

### 4.1 INTRODUCTION

### 4.2 RESEARCH PHASES

#### 4.2.1 STATE OF THE ART

#### 4.2.2 OBJECTIVES

#### 4.2.3 METHODOLOGICAL DEVELOPMENT OF THE RESEARCH

#### 4.2.4 CONCLUSIONS

### 4.3 THE SURVEY AS A RESEARCH TECHNIQUE

#### 4.3.1 JUSTIFICATION FOR THE SELECTION OF A SURVEY AS A RESEARCH TECHNIQUE

#### 4.3.2 FIELD WORK

#### 4.3.3 DESIGN OF QUESTIONNAIRES

### 4.4 THE SURVEYED SAMPLE

### 4.5 RESULTS AND ANALYSIS

#### 4.5.1 RESULTS

#### 4.5.2 INTERPRETATION AND ANALYSIS

### 4.6 SUMMARY

## 5 RESULTS

### 5.1 INTRODUCTION

### 5.2 PART 1 WEB SURVEY: INTRODUCTION

### 5.3 PART 2 WEB SURVEY: GENERAL

### 5.4 PART 3 WEB SURVEY: QUALITY
1 Introduction

Since 1996 the standards of the ISO 14000 were published, it has been spread among companies of the construction sector the implementation of environmental management systems (EMS) in accordance with these rules [19].

After several years of its enactment, ISO 14001:1996 has been revised. In fact, on November 15, 2004 it was repealed and replaced by the UNE-EN ISO 14001:2004. This new version maintains the same structure, and tends to clarify the interpretation of the basic requirements, rather than incorporating new ones. Today this standard is undergoing a second review to ensure that it remains relevant in the next two decades. It is estimated that this third version will be released in 2015 [12, 14].

In this regard it should be highlighted the fact that the construction sector has a number of peculiarities that have a decisive influence on the implementation of EMS. Specifically, there is the difficulty of implementing this management system in the workplace, that is, works, because of their temporal and spatial variability [19].

On the other hand, the increased social awareness on environmental issues has also encouraged a change in the behaviour of promoters of civil engineering projects, who have begun to enter into tendering some environmental approach, asking the contractor from the submission of Environmental Monitoring Plan (EMP) to an EMS certification by a recognized body [19]. Construction projects pose enormous challenges to not only finish within an owner’s schedule and budget, but to also eliminate and minimize harmful impacts to the environment. Construction has significant impacts on the natural environment. Even a minor impact, such as a small release or spill of a hazardous substance, can cause a health or environmental threat and lead to costly cleanup activities. In many instances, a company’s impact can be attributed to the lack of an adequate environmental management system [7].

The different developed countries, both in the European Union (EU) and around the world, do weight this increasingly social and environmental dimension more and more along with the economic data. Therefore, those ecological and socially irresponsible methods used in business begin to be discounted, both by stock markets and by themselves as consumers. The EU supports the revision and development of environmental management systems, with the consequent improvement of information and awareness of available technical improvements, cleaner technologies and dissemination of good environmental practices. The EU does also provide legislative improvements in the control of industrial pollution and
greater integration of external costs with particular attention to technical and financial obstacles [45].

However, many companies overlook the importance of considering the environment within its overall management system, which may be due to ignorance or lack of information on these issues, to the costs that are involved, and/or to a lack of working responsibilities. These circumstances are especially delicate when the medium in which the action takes place is an area of special environmental interest (sensitive areas, protected areas, forests, etc.) [45].

Furthermore, in the sector of civil construction the majority of the civil works are subcontractors, a reality that demands specific modes for the implantation of EMS. Each subcontractor carries out specialized tasks dealing with its participation in a civil work, though a negative impact to the environment may be provoked by the use of their machinery and equipment. In addition, the variety of activities that a civil work implies complicates the design and development of a specific environmental training program in which its responsibilities are defined in reference to the environmental aspects that these activities generate in accordance to the building stage in which they are enrolled.

The incorporation by civil construction companies in the concern for the environment will lead into the emergence of new attitudes and behaviours both individual and corporate. This will result in savings not only of energy consumption, but also of raw materials. Also, environment considerations will definitely lead to a decrease in administrative and legal costs brought about by not environmentally respectful behaviours [45].

Thus arises one of the overall objectives of this document, which is to analyze the implementation of these management systems in construction industry. In this paper, we discuss environmental management systems and the ISO 14001 standard in particular. We summarize experience and literature on construction EMSs, including a case study of an ISO 14001 in construction firms. Our intent is to summarize the necessary elements of an EMS, the potential benefits and the importance for construction firms to implement such systems. An EMS involves the formal system and database, which integrates procedures and processes for the training of personnel, monitoring, summarising, and reporting of specialised environmental performance information to internal and external stakeholders of the company.

The choice of European companies and especially those of the Republic of Slovenia is based on the study that has been developed during my stay at the University of Ljubljana, specifically in the Civil Engineering Faculty doing the Erasmus exchange student program. Initially, this investigation arises from the idea of analyzing the evolution that Slovenian construction companies have gone through since year 2006, when a last study on the
implementation of the EMS in this country was carried out by PhD. Jana Šelih [56], external tutor of the present study.

As time goes by, and because this region has a reduced surface area, the study has been also extended to Italian, Austrian, Croatian and Spanish companies where many infrastructures of all types are concentrated. It is precisely such a circumstance which favours the progress of this research and allows us to generalize and spread its results to a more European level for being them considered representative enough.

We have considered different companies operating with different types of civil engineering works (roads, railways, hydraulics, airports, residential, etc.) as well as those companies responsible for developing and providing various building materials, and engineering companies.

Firstly, in chapter 2 describes the historical development and introduction of environmental management practices in the construction sector, the trend towards the implementation of EMS in companies of the sector, and the requirements of the EMS according to ISO 14001:2004, which is the reference standard form mainly adopted by construction companies. To a lesser extent there is a reference to the ISO 9001:2008.

Once the description of the rules has already been provided, and being chapter 3 the one in which the general objectives to be achieved with the present investigation have been analyzed, the research is now designed to follow the sequence described in chapter 4. In this section, called “Methodology”, the methods that have been used in this investigation are described and justified, as well as the different steps that we have gone through in order to obtain the data that has been used in later chapters.

In chapter 5 the results of the investigation are provided in the form of tables that represent the percentages and number of answers for the companies that have participated in this study.

Chapter 6 is the longest of the present study, and in it the different obtained results are interpreted and analyzed. Once this task is done, the conclusions to which we have reached at the end of the investigation are described in chapter 7.

Finally, chapter 8 there is a list of the bibliographical references that have been used for the elaboration of the study.

In the different annexes it can be found the diverse versions of the questionnaires that were sent to companies of the construction sector, as well as an excel pdf copy that was used for the statistical treatment of the obtained results.
2 Literature Review

2.1 INTRODUCTION

In this chapter we will be dealing with the relation between the construction sector and the environment, together with the benefits of the application of the ISO 14001 in this sector.

We do also carry out a deep analysis on the ISO 14001, especially in the case of European construction companies. By introducing the ISO we do also define the concept of EMS, since it is associated with this standard.

At the very end of the chapter a brief description of the ISO 9001 is provided, though before this a review is made on the literary survey that has been used for the development of the web survey that has been sent to the different companies of the construction sector.

Then, with everything that has been defined in this section we finally obtain the necessary framework to understand the meaning and relevance of the environmental management systems.

2.2 ISO

ISO (the International Organization for Standardization) is a worldwide federation of national standard bodies (ISO member bodies). The work of preparing International Standards is normally carried out through ISO technical committees. Each member body interested in a subject for which a technical committee has been established has the right to be represented on that committee. International organizations, governmental and non-governmental, in liaison with ISO, also take part in the work [28].

The main task of technical committees is to prepare International Standards. Draft International Standards adopted by the technical committees are circulated to the member bodies for voting. Publication as an International Standard requires approval by at least 75 % of the member bodies casting a vote [28].

2.3 DEVELOPMENT OF THE ISO 14000 SERIES OF STANDARDS

The ISO 14000 family addresses various aspects of environmental management. It provides practical tools for companies and organizations looking to identify and control their environmental impact and constantly improve their environmental performance. Its objective is to minimize how their operations (processes etc.) negatively affect the environment (that is to say, cause adverse changes to air, water, or land), comply with applicable laws, regulations, and other environmentally oriented requirements, and continually improve in the above. The
ISO 14000 series cover 6 areas: EMS, environmental auditing and related investigations; environmental labelling; environmental performance evaluation; lifecycle assessment; and terms and definitions [1, 28, 29].

The ISO 14000 family includes most notably the ISO 14001 standard, which represents the core set of standards used by organizations for designing and implementing an effective environmental management system (EMS). In summary, the standard provides guidelines for implementing an EMS, and it is a voluntary certificate to which organizations choose to become certified. Other standards included in this series are ISO 14004, which gives additional guidelines for a good environmental management system, and more specialized standards dealing with specific aspects of environmental management. The major objective of the ISO 14000 series of norms is "to promote more effective and efficient environmental management in organizations and to provide useful and usable tools - ones that are cost effective, system-based, flexible and reflect the best organizations and the best organizational practices available for gathering, interpreting and communicating environmentally relevant information" [1, 28, 29, 63].

Prior to the development of the ISO 14000 series, organizations voluntarily constructed their own EMS systems, but this made comparisons of environmental effects between companies were different, and therefore the universal ISO 14000 series was developed. An EMS is defined by ISO as “part of the overall management system that includes organizational structure, planning activities, responsibilities, practices, procedures, processes and resources for developing, implementing, achieving and maintaining the environmental policy” [1, 29].

The requirements of ISO 14000 are an integral part of the European Union’s Eco-Management and Audit Scheme (EMAS). EMAS’s structure and material requirements are more demanding, foremost concerning performance improvement, legal compliance and reporting duties [1, 5, 63].

The concept of an environmental management system evolved in the early nineties and its origin can be traced back to 1972, when the first Earth Summit was held in Rio-de-Janeiro, which served to generate a global commitment to the environment. In the same year, BSI Group published the world's first environmental management systems standard, BS 7750. This supplied the template for the development of the ISO 14000 series in 1996, by the International Organization for Standardization, which has representation from committees all over the world (ISO) [1, 5, 29]. The first draft of these series of standards was published in
1996 and subsequently revised in 2004. As of 2010, ISO 14001 is now used by at least 223,149 organizations in 159 countries and economies [12].

**2.4 EMS AND ISO 14001**

**2.4.1 EMS**

An EMS is defined by the British Standards Institute (BSI) as the organizational structure, responsibilities, practices, procedures, processes and resources for determining and implementing environmental policy [1, 6, 29, 63]. Similar definitions are found in the EU Eco-Management and Audit Scheme (EMAS) and ISO 14001. Not like legislation, EMS is a voluntary tool which can help companies to control environmental impact caused by their operations [6, 29, 63].

Despite the fact that different companies may develop different environmental management systems, usually there are some common steps that can be found in these EMSs, mainly because most of them were designed based on the steps of quality management system such as ISO 9000 [6, 29, 63]. Therefore, it is possible to create a standard for environmental management systems in order to ensure a certain quality for the EMS, and to encourage organizations to improve their environmental performance [5, 6].

In the last few years a number of voluntary environmental management schemes have been developed. The standard-BS 7750- was published by BSI in March 1992 and was the world’s first environmental management system standard. At the same time that BSI began work on BS 7750, the European Commission was setting out its proposal for an eco-audit scheme and it was from this proposal that EMAS eventually emerged in 1993. In the same year of EMAS publishing, the activity relating to environmental management system standardization began on the international scene. And after a development time of a little less than three years, ISO 14000 series were published in October 1996 and ISO 14001 was revised in 2004, which is the version that is being used nowadays [1, 5, 6, 29, 63].

The standardized environmental management systems are voluntary and are designed to be externally verified by nationally accredited bodies, in a similar way as the quality standard ISO 9000. It is argued that companies that register with the schemes, gaining the EMAS and ISO14001 accreditation, will experience added values such as market advantages and legal compliance [5, 6, 29, 63].

In this document we have focused our attention specifically on the ISO 14001:2004, since it is the most widespread standard in companies in general.
2.4.2 ISO 14001

ISO 14001 sets out the criteria for an environmental management system, and it does not state requirements for environmental performance, but maps out a framework that a company or organization can follow to set up an effective environmental management system. It can also be used by any organization regardless of its activity or sector. Using ISO 14001 can provide assurance to the company management and employees as well as external stakeholders that environmental impact is being measured and improved. ISO 14001 can also be integrated with other management functions and it assists companies in meeting their environmental and economic goals [5, 6, 29, 63].

ISO 14001, as with other ISO 14000 standards, is voluntary, with its main aim to assist companies in continually improving their environmental performance, whilst complying with any applicable legislation. Organizations are responsible for setting their own targets and performance measures, with the standard serving to assist them in meeting objectives and goals and the subsequent monitoring and measurement of these [29, 63].

The standard can be applied to a variety of levels in the business, from organizational level, right down to the product and service level. Rather than focusing on exact measures and goals of environmental performance, the standard highlights what an organization needs to do to meet these goals. Success of the system is very dependant on commitment from all levels of the organization, especially top management, who need to be actively involved in the development, implementation and maintenance of the environmental management system [29, 63].

ISO 14001 is known as a generic management system standard, meaning that it is relevant to any organization seeking to improve and manage resources more effectively [29, 63].

All standards are periodically reviewed by ISO to ensure they still meet the market requirements. The current version of ISO 14001 – ISO 14001:2004 is under review as of April 2012 [12, 28].

Many organizations have undertaken environmental “reviews” or “audits” to assess their environmental performance. On their own, however, these “reviews” and “audits” may not be sufficient to provide an organization with the assurance that its performance not only meets, but will continue to meet its legal and policy requirements. To be effective, they need to be conducted within a structured management system that is integrated within the organization [5, 6].
ISO 14001 standard specifies requirements for an environmental management system to enable an organization to develop and implement a policy and also the objectives that take into account legal requirements and information about significant environmental aspects. It is intended to apply to all types and sizes of organization and to accommodate diverse geographical, cultural and social conditions. The basis of the approach is shown in Figure 1. The success of the system depends on commitment from all levels and functions of the organizations, and especially from top management. A system of this kind enables an organization to develop an environmental policy, establish objectives and processes to achieve the policy commitments, take action as needed to improve its performance and demonstrate the conformity of the system to the requirements of this International Standard. The overall aim of this International Standard is to support environmental protection and prevention of pollution in balance with socio-economic needs. It should be noted that many of the requirements can be addressed concurrently or revisited at any time [29, 63].

The second edition of this International Standard is focused on clarification of the first edition, and has taken to consideration of the provisions of ISO 9001 to enhance the compatibility of the two standards for the benefit of the user community [28, 29].

There is an important distinction between this International Standard, which describes the requirements for an organization's environmental management system and can be used for certification/registration and/or self-declaration of an organization's environmental management system, and a non-certifiable guideline intended to provide generic assistance to an organization for establishing, implementing or improving an environmental management system. Environmental management encompasses a full range of issues, including those with strategic and competitive implications. Demonstration of successful implementation of this International Standard can be used by an organization to assure interested parties that an appropriate environmental management system is in place [29, 63].
2.4.3 Basic principles and methodology

Plan – established objectives and processes required

Prior to implementing ISO 14001, an initial review or gap analysis of the organization’s processes and products is recommended to assist in identifying all elements of the current operation and, if possible, future operations that may interact with the environment, termed environmental aspects. These aspects can include both direct, such as those used during manufacturing and indirect, such as raw materials. This review assists the organization in establishing their environmental objectives, goals and targets, which should ideally be measurable; helps with the development of control and management procedures and processes and serves to highlight any relevant legal requirements, which can then be built into the policy [5, 6].

Do – implement the processes

During this stage the organization identifies the resources required and works out those members of the organization responsible for the EMS implementation and control. This includes documentation of all procedures and processes; including operational and documentation control, the establishment of emergency procedures and responses, and the education of employees, to ensure they can competently implement the necessary
Study on Environmental Management Systems in construction companies

processes and record results. Communication and participation across all levels of the organization, especially top management, is a vital part of the implementation phase, with the effectiveness of the EMS being dependant on active involvement from all employees [5, 6].

**Check – measure and monitor the processes and report results**

During the check stage, performance is monitored and periodically measured to ensure that the organization’s environmental targets and objectives are being met [5, 6]. In addition, internal audits are regularly conducted to ascertain whether the EMS itself is being implemented properly and whether the processes and procedures are being adequately maintained and monitored [5, 6].

**Act – take action to improve performance of EMS based on results**

After the checking stage, a regular planned management review is conducted to ensure that the objectives of the EMS are being met, the extent to which they are being met, that communications are being appropriately managed and to evaluate changing circumstances, such as legal requirements, in order to make recommendations for further improvement of the system. These recommendations are then fed back into the planning stage to be implemented into the EMS moving forward [5, 6].

**Continual Improvement Process**

The core requirement of a Continual Improvement Process (CIP) is different from the one known from quality management systems. CIP in ISO 14001 has three dimensions [5, 6]:

- **Expansion**: More and more business areas get covered by the implemented EMS.
- **Enrichment**: More and more activities, products, processes, emissions, resources etc. are managed by the implemented EMS.
- **Upgrading**: An improvement of the structural and organizational framework of the EMS, as well as an accumulation of know-how in dealing with business related environmental issues.
- Overall, the CIP-concept expects the organization to gradually move away from merely operational environmental measures towards a strategic approach on how to deal with environmental challenges.

This International Standard does not establish absolute requirements for environmental performance beyond the commitments, in the environmental policy, to comply with applicable legal requirements and with other requirements to which the
organization subscribes, to prevention of pollution and to continual improvement. Thus, two organizations carrying out similar operations but having different environmental performance can both conform to its requirements [29, 63].

The adoption and implementation of a range of environmental management techniques in a systematic manner can contribute to optimal outcomes for all interested parties. However, adoption of this International Standard will not in itself guarantee optimal environmental outcomes. In order to achieve environmental objectives, the environmental management system can encourage organizations to consider the implementation of the best available techniques, where appropriate and where economically viable, and fully take into account the cost-effectiveness of such techniques [29, 63].

The level of detail and complexity of the environmental management system, the extent of documentation and the resources devoted to it depend on a number of factors, such as the scope of the system, the size of an organization and the nature of its activities, products and services. This may be the case in particular for small and medium-sized enterprises [29, 63].

2.5 BENEFITS ISO 14001

The ISO 14001 was developed primarily to assist companies in reducing their environmental impacts, but in addition to an improvement in environmental standards and performance, organizations can reap a number of economic benefits including higher conformance with legislative and regulatory requirements by using the ISO standard [5, 63].

Firstly, by minimizing the risk of regulatory and environmental liability fines and improving an organization’s efficiency [9], leading to a reduction in waste and consumption of resources, operating costs can be reduced. Secondly, as an internationally recognized standard, businesses operating in multiple locations across the globe can register as ISO 14001 compliant, eliminating the need for multiple registrations or certifications [5]. Thirdly, there has been a push in the last decade by consumers for companies to adopt stricter environmental regulations, making the incorporation of ISO 14001 a greater necessity for the long term viability of businesses [9] and providing them with a competitive advantage against companies that do not adopt the standard [5]. This in turn can have a positive impact on a company’s asset value [5] and can lead to improved public perceptions of the business, placing them in a
better position to operate in the international marketplace [5]. Certification to ISO 14001 can demonstrate an innovative and forward thinking approach to customers and prospective employees; it can increase a business’s access to new customers and business partners; and it can potentially reduce public liability insurance costs. Finally, it can serve to reduce trade barriers between registered businesses [5].

Organizations can significantly benefit from EMS implementation through the identification of large cleaner production projects (for example, those that can drastically cut electricity costs in manufacturing industries). ISO 14001 can be a very effective tool to identify these cost saving opportunities for some organizations. Some of them can falter in their planning because of a lack of senior management commitment and a poor understanding of how ISO 14001 should be implemented and find themselves managing an ineffective EMS. Improvements that organizations can make include adequately planning their structure and allocating adequate resources, providing training, creating forums for discussion, setting measurable targets and working according to the philosophy of continuous improvement [5].

In summary, the benefits of using ISO 14001 can include:

- Reduced cost of waste management.
- Savings in consumption of energy and materials.
- Lower distribution costs.
- Improved corporate image among regulators, customers and the public.

2.6 ISO 14001 AND EMAS

The Eco-Management and Audit Scheme (EMAS) is a voluntary environmental management instrument which was developed in 1993 by the European Commission, and it enables organizations to assess, manage and continuously improve their environmental performance. The scheme is globally applicable and open to all types of private and public organizations, though in order to register with EMAS, organizations must meet the requirements of the EU EMAS-Regulation. Currently, more than 4,600 organizations and more than 7,900 sites are EMAS registered [6, 28].

All organisations listed in the EMAS-Register run an environmental management system according to the EMAS requirements. Because ISO 14001 is an integral part of EMAS, these organisations automatically comply with the requirements that the international standard demands as well. However, EMAS registered organisations fulfil
requirements that go beyond the scope of ISO 14001. EMAS registered organisations demonstrate [5, 6, 63];

• Credibility: the proper implementation of EMAS is assessed by qualified and independent environmental verifiers.

• Transparency: by periodically reporting on their environmental performance. Those reports include information on key performance indicators, and they must be validated by an environmental verifier.

• Continuous improvement process: by committing themselves to continuous improvement of their actual environmental performance, which is also evaluated by an environmental verifier. ISO 14001 only requires improving the environmental management system itself.

• Compliance: by fully complying with applicable environmental legislation.

• Stakeholder engagement: by involving employees and other stakeholders in order to benefit from their commitment, ideas, skills and experiences.

2.7 ISO 14001 CERTIFICATION OF COMPANIES IN EUROPE; THE CASE OF CONSTRUCTION INDUSTRY

Among the major industries, the construction industry is closely related to the environment. All the construction activities have either direct or indirect effects on the environment.

An increasing number of companies worldwide are seeking the ISO 14001 certification, to which, in many cases, they are driven by business requirements; often this certification is perceived as a measure for enhanced competitiveness and prestige. Obviously, there are other factors such as the magnitude of environmental degradation, general environmental awareness, environmental regulations and governmental incentives in a particular country, that influence the actual number of certified companies [28].

Thus, there are growing studies and literatures about the relationship between construction and EMSs or benefits accrued to the construction industry from implementation of ISO14001 EMS [5, 6, 31] discussed the differences between eco-labelling and ISO14001 in the construction industry and concluded that the industry has a great potential to do more to reduce the environmental impact, while eco-labelling is a scheme that tried to assess the overall impact on the environment from the building [5]. The author also suggested in his research ‘ISO14001 in particular, seems to be a much
better way of steering the construction industry towards improved environmental performance’ [5]. Ofori et al. [43] concluded the research by stressing that contractors have the major responsibility for environmental management, and that EMS is essential to act as a tool to drive them to succeed. If the ISO14001 is properly implemented, it helps to win more businesses as reputation and image of construction companies are usually important considerations to compete for projects [31]. Also, through improving environmental performances and contributing to sustainable development, companies can reduce costs in production and operation [5].

Although construction industry has such a subtle relationship with the environment, and despite ISO14001 is a well established international standard, the proportion of non-ISO accredited construction companies seems far more than that of the ISO-accredited companies. Up to the end of 2000, there were total 22,897 ISO14001 certified companies around the world, and there were only 1,035 certificates belonging to the construction sector [12]. As the awareness of the industry increases, the total ISO14001 certified construction companies keep increasing in the past decade [12]. Scholars claim the construction industry acknowledge the significant environmental impacts they have been creating [31, 43] and therefore, the industry has the consensus to improve their environmental performances over the years through obtaining the ISO14001 EMS certification [5].

However, barriers for implementing ISO14001 in the industry did still exist such as lack of supply chain co-operation, lack of trained staff and expertise or high management and operation costs [5], which level off the motivations. Thus, there is a need to address the reasons that limit the ISO14001 certification since, is that because of the nature of the industry or because of the implementation barriers? Or is it just a normal variation between practices? At the same time, there remains a noticeable variation within the industries, and within and between countries, in the validity of firm’s commitment to environmental performance and the specific approaches taken [5].

The upward trend of companies with ISO 14001 certificate in European Union from 1999 to 2011 is clearly shown in Table 1. The data are compiled from http://www.iso.org/iso/home.html [12].
<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Austria</td>
<td>156</td>
<td>203</td>
<td>223</td>
<td>429</td>
<td>500</td>
<td>549</td>
<td>481</td>
<td>553</td>
<td>697</td>
<td>837</td>
<td>919</td>
<td>1182</td>
<td>963</td>
</tr>
<tr>
<td>Belgium</td>
<td>74</td>
<td>130</td>
<td>130</td>
<td>264</td>
<td>391</td>
<td>642</td>
<td>659</td>
<td>521</td>
<td>632</td>
<td>730</td>
<td>796</td>
<td>819</td>
<td>724</td>
</tr>
<tr>
<td>Bulgaria</td>
<td>-</td>
<td>-</td>
<td>6</td>
<td>10</td>
<td>26</td>
<td>49</td>
<td>92</td>
<td>214</td>
<td>321</td>
<td>565</td>
<td>999</td>
<td>927</td>
<td>-</td>
</tr>
<tr>
<td>Croatia</td>
<td>8</td>
<td>8</td>
<td>19</td>
<td>35</td>
<td>53</td>
<td>84</td>
<td>130</td>
<td>181</td>
<td>258</td>
<td>343</td>
<td>469</td>
<td>451</td>
<td>488</td>
</tr>
<tr>
<td>Cyprus</td>
<td>3</td>
<td>4</td>
<td>4</td>
<td>21</td>
<td>40</td>
<td>56</td>
<td>61</td>
<td>59</td>
<td>56</td>
<td>71</td>
<td>113</td>
<td>136</td>
<td>107</td>
</tr>
<tr>
<td>Czech Republic</td>
<td>60</td>
<td>116</td>
<td>174</td>
<td>318</td>
<td>519</td>
<td>1288</td>
<td>2122</td>
<td>2211</td>
<td>2731</td>
<td>3318</td>
<td>4684</td>
<td>6629</td>
<td>4451</td>
</tr>
<tr>
<td>Denmark</td>
<td>320</td>
<td>532</td>
<td>620</td>
<td>711</td>
<td>486</td>
<td>711</td>
<td>837</td>
<td>995</td>
<td>982</td>
<td>873</td>
<td>947</td>
<td>1009</td>
<td>994</td>
</tr>
<tr>
<td>Estonia</td>
<td>4</td>
<td>18</td>
<td>24</td>
<td>47</td>
<td>74</td>
<td>86</td>
<td>148</td>
<td>173</td>
<td>169</td>
<td>233</td>
<td>263</td>
<td>306</td>
<td>358</td>
</tr>
<tr>
<td>Finland</td>
<td>470</td>
<td>508</td>
<td>687</td>
<td>750</td>
<td>1128</td>
<td>882</td>
<td>923</td>
<td>935</td>
<td>822</td>
<td>991</td>
<td>1107</td>
<td>1122</td>
<td>1169</td>
</tr>
<tr>
<td>France</td>
<td>462</td>
<td>710</td>
<td>1092</td>
<td>1467</td>
<td>2344</td>
<td>2955</td>
<td>3289</td>
<td>3047</td>
<td>3476</td>
<td>3482</td>
<td>4678</td>
<td>5251</td>
<td>7771</td>
</tr>
<tr>
<td>Germany</td>
<td>962</td>
<td>1260</td>
<td>3380</td>
<td>3700</td>
<td>4144</td>
<td>4320</td>
<td>4440</td>
<td>5415</td>
<td>4877</td>
<td>5709</td>
<td>5865</td>
<td>6001</td>
<td>6253</td>
</tr>
<tr>
<td>Greece</td>
<td>20</td>
<td>42</td>
<td>66</td>
<td>89</td>
<td>126</td>
<td>173</td>
<td>254</td>
<td>259</td>
<td>278</td>
<td>463</td>
<td>455</td>
<td>560</td>
<td>543</td>
</tr>
<tr>
<td>Hungary</td>
<td>121</td>
<td>164</td>
<td>340</td>
<td>640</td>
<td>770</td>
<td>882</td>
<td>993</td>
<td>1140</td>
<td>1537</td>
<td>1834</td>
<td>1659</td>
<td>1822</td>
<td>1580</td>
</tr>
<tr>
<td>Ireland</td>
<td>115</td>
<td>163</td>
<td>247</td>
<td>289</td>
<td>218</td>
<td>294</td>
<td>282</td>
<td>251</td>
<td>370</td>
<td>515</td>
<td>527</td>
<td>596</td>
<td>663</td>
</tr>
<tr>
<td>Italy</td>
<td>243</td>
<td>521</td>
<td>1295</td>
<td>2153</td>
<td>3066</td>
<td>4785</td>
<td>7080</td>
<td>9825</td>
<td>12057</td>
<td>12922</td>
<td>1454</td>
<td>1706</td>
<td>2100</td>
</tr>
<tr>
<td>Latvia</td>
<td>4</td>
<td>4</td>
<td>4</td>
<td>20</td>
<td>3</td>
<td>78</td>
<td>90</td>
<td>101</td>
<td>40</td>
<td>79</td>
<td>142</td>
<td>239</td>
<td>250</td>
</tr>
<tr>
<td>Lithuania</td>
<td>1</td>
<td>10</td>
<td>21</td>
<td>33</td>
<td>72</td>
<td>155</td>
<td>208</td>
<td>252</td>
<td>312</td>
<td>402</td>
<td>521</td>
<td>686</td>
<td>703</td>
</tr>
<tr>
<td>Luxembourg</td>
<td>6</td>
<td>9</td>
<td>9</td>
<td>17</td>
<td>32</td>
<td>39</td>
<td>34</td>
<td>18</td>
<td>40</td>
<td>50</td>
<td>56</td>
<td>19</td>
<td>28</td>
</tr>
<tr>
<td>Malta</td>
<td>-</td>
<td>2</td>
<td>2</td>
<td>3</td>
<td>4</td>
<td>4</td>
<td>5</td>
<td>6</td>
<td>8</td>
<td>10</td>
<td>16</td>
<td>18</td>
<td>-</td>
</tr>
<tr>
<td>Netherlands</td>
<td>403</td>
<td>784</td>
<td>942</td>
<td>1073</td>
<td>1162</td>
<td>1150</td>
<td>1107</td>
<td>1128</td>
<td>1183</td>
<td>1314</td>
<td>1326</td>
<td>1494</td>
<td>1681</td>
</tr>
<tr>
<td>Poland</td>
<td>72</td>
<td>66</td>
<td>594</td>
<td>434</td>
<td>555</td>
<td>709</td>
<td>948</td>
<td>837</td>
<td>1089</td>
<td>1544</td>
<td>1500</td>
<td>1793</td>
<td>1900</td>
</tr>
<tr>
<td>Portugal</td>
<td>28</td>
<td>47</td>
<td>88</td>
<td>137</td>
<td>248</td>
<td>404</td>
<td>504</td>
<td>564</td>
<td>456</td>
<td>534</td>
<td>632</td>
<td>838</td>
<td>836</td>
</tr>
<tr>
<td>Romania</td>
<td>1</td>
<td>5</td>
<td>15</td>
<td>45</td>
<td>96</td>
<td>361</td>
<td>752</td>
<td>1454</td>
<td>2269</td>
<td>3884</td>
<td>6863</td>
<td>7418</td>
<td>9557</td>
</tr>
<tr>
<td>Slovakia</td>
<td>24</td>
<td>36</td>
<td>73</td>
<td>70</td>
<td>165</td>
<td>184</td>
<td>222</td>
<td>305</td>
<td>437</td>
<td>672</td>
<td>746</td>
<td>1102</td>
<td>1152</td>
</tr>
<tr>
<td>Slovenia</td>
<td>19</td>
<td>88</td>
<td>136</td>
<td>149</td>
<td>265</td>
<td>338</td>
<td>417</td>
<td>379</td>
<td>438</td>
<td>444</td>
<td>390</td>
<td>399</td>
<td>414</td>
</tr>
<tr>
<td>Spain</td>
<td>573</td>
<td>600</td>
<td>2064</td>
<td>3228</td>
<td>4860</td>
<td>6473</td>
<td>8620</td>
<td>11125</td>
<td>13852</td>
<td>16443</td>
<td>1652</td>
<td>1834</td>
<td>1634</td>
</tr>
<tr>
<td>Sweden</td>
<td>851</td>
<td>1370</td>
<td>2070</td>
<td>2730</td>
<td>2330</td>
<td>3478</td>
<td>3682</td>
<td>3759</td>
<td>3800</td>
<td>4478</td>
<td>4193</td>
<td>4622</td>
<td>4048</td>
</tr>
<tr>
<td>United Kingdom</td>
<td>1492</td>
<td>2534</td>
<td>2722</td>
<td>2917</td>
<td>5460</td>
<td>6253</td>
<td>6055</td>
<td>6070</td>
<td>7323</td>
<td>9455</td>
<td>1091</td>
<td>1434</td>
<td>1523</td>
</tr>
<tr>
<td>TOTAL</td>
<td>7253</td>
<td>1979</td>
<td>1794</td>
<td>2330</td>
<td>3091</td>
<td>3980</td>
<td>4783</td>
<td>55919</td>
<td>65097</td>
<td>78118</td>
<td>8923</td>
<td>1031</td>
<td>1067</td>
</tr>
</tbody>
</table>

Table 1. Number of companies holding the ISO 14001 certificate in EU countries.
Graphic 1. Number of companies holding the ISO 14001 certificate per million inhabitants in EU countries.

Graphic 2. Number of companies holding the ISO 14001 certificate in EU countries.
Study on Environmental Management Systems in construction companies

Graphic 3. Number of ISO 14001 certified companies in each European Union country in 2011.

Graphic 4. Number of certified ISO 14001 in construction companies.
In Table 1 a close observation of the data indicates that the highest number of certificates in 2001 was awarded to Italian companies with 21,009 certificates. This is followed by Spain with 16,341, United Kingdom with 15,231 and Rumania with 9,557 certificates. If we look at the percentage of companies per million inhabitants in year 2011, we observe countries as Sweden, Rumania and Check Republic that highlight the most [12]. From the countries that comform this study we observe:

- Austria, with a total of 963 companies holding ISO 14001 and 117 companies / 1000 000 inhabitants.
• Croatia, with a total of 488 companies holding ISO 14001 and 109 companies / 1000 000 inhabitants.
• Italy with a total of 21,009 companies holding ISO 14001 and 343 companies / 1000 000 inhabitants.
• Slovenia, with a total of 414 companies holding ISO 14001 and 207 companies / 1000 000 inhabitants.
• Spain, with a total of 16,341 companies holding ISO 14001 and 347 companies / 1000 000 inhabitants.

With respect to the construction industry in 2011 a total of 34,155 companies were holding the ISO 14001. In engineering companies a total of 8189 have the ISO 14001 and with respect to manufacturing building material companies, they sum up to 23,956 [12]. In this last group we have taken into account companies that make:
• Wood and wood products.
• Concrete, cement, lime, plaster, etc.
• Basic metal & fabricated metal products.

Although the number of organisations with ISO 14001 certificates is large and growing fast, the constructions sector lags well behind this general trend. The traditional construction project goals, specified level of quality, completion in time and limitation of costs do not take into account the environmental goals, as proposed in [56, 57]. As already mentioned, there are driving forces that lead to the new paradigm illustrated schematically in Fig. 2 [56, 57], and among them, it can be found environmental education and awareness, pressure from clients and governmental regulations, need for improved public image, and stakeholders’ involvement, these same forces, at organisation’s level, lead to the implementation of an EMS.

Projects promoting the EMS implementation in the industry are being initiated by governmental agencies and NGO’s worldwide. To ensure the success of such projects (that is to say, to achieve an increase of the number of the EMS certificates), the initial environmental awareness level, the main drivers and barriers related to the EMS implementation have to be identified in advance. Furthermore, the outreach should be tailored to the business sector and, most likely, it cannot be or should not be generalised [56, 57].
In what the construction sector is concerned, the approach used in these projects should account for the special features and differences between the construction sector and the manufacturing industry. Various participants are encountered in a construction project: the client as the key stakeholder initiating the project, the designer, contracting and subcontracting companies, and various suppliers, consultants. The construction sector is therefore highly fragmented and consists of business entities of various size and trades. Furthermore, it can be noticed that a large portion of construction companies can be classified as small or medium-size enterprises (SMEs) [56].

The approach used to promote the ISO 14001 compliant EMS implementation in any industrial sector has to be different for small and medium enterprises (SMEs) and for large, corporate construction companies. This also holds true for the construction industry. The approach should be formulated on the basis of an empirical determination of construction industry views [56].

2.8 LITERATURE SURVEY

2.8.1 Introduction

Two areas of uncertainty are proved to be the major obstacles to the widespread adoption of EMSs by manufacturing companies. The first one stems from the ambiguity of the relationship between pollution reduction and profitability. The second arises from the lack of reliable information about the differences in tangible benefits derived from
formal, even certified EMSs versus those from an informal or less rigorous set of environmentally focused activities [37, 56].

For a long time, the erroneous view has prevailed that pursuing environmental goals was opposed to a sound business strategy. A conventional consensus held then was that any investment in an improved environmental performance would contribute to penalties such as increased lead times, reduced quality or increased costs, all of which reduced the profits [37, 56]. It was only in the 1990’s that these views were challenged by various authors [32, 56]. Despite considerable debate and some evidence of the contrary, these views are still supported by many sectors [37, 56]. It is a fact that impacts on EMSs as a whole, and in particular their environmental and business performance, are, in general, difficult to assess accurately, and a systematic research in this area is lacking [56]. One of the few studies on this topic [37, 56] empirically confirms the hypothesis that the improved performance (measured by reduction of costs, improved quality, reduction of waste and increased lead times) has been registered after the company introduced a formal EMS.

Implementing an EMS is not a trivial decision, as it requires significant and ongoing staff commitment and effort, increased documentation and paperwork, potential need and introduction of new technologies and large intangible costs related to the organisational change [56].

In general, the companies decide to establish an EMS because the projected benefits are larger than the projected barriers. The drivers, that is to say, the factors that create or change the organisation’s performance, are directly relate to the anticipated benefits [56] and they can be divided into internal (arising within the company) and external (arising from the company’s environment) drivers. The following general drivers have been identified in the literature [56]:

- Corporate policies are an important external driver, as a large proportion of the companies are encouraged to adopt an EMS by the parent organisation.
- Regulatory expectations, or desire to improve compliance, are one of the strongest external drivers.
- Market forces are extremely important for business entities. Both customer demands and public-relations benefits, ie improved public image of the company, can be influential drivers for EMS adoption.
- Government assistance can be carried out in various ways. In general, it is assumed that providing financial or expert support during the EMS
implementation facilitates the process and is therefore an important external driver.

- Cost reduction is an important internal driver for every business entity and can be achieved by reducing the potential for pollution occurrence.
- Organisational culture is an internal driver that should not be overlooked. If it is positive against the environmental issues, it can encourage the management to initiate the EMS implementation. This makes sense also because the EMS implementation requires a substantial investment into human resources, and this investment might be lost if it is fundamentally in conflict with the organisation’s philosophy of doing business.

In summary, the EMSs can be potentially attractive to the management as they may provide companies with unique environmental resource, capabilities and benefits that can lead to competitive advantages [33, 53, 56].

### 2.8.2 Construction sector and EMS implementation

The following barriers valid for the case of construction industry were identified during the discussion with practitioners as well as in the literature [7, 43, 59]:

- **Client’s role**: his role in the construction project needs to be recognised as a crucial factor that influences also the site and organisation management systems [43].
- **Subcontracting system**: typically, several subcontracting companies participate in a construction project. This creates an additional difficulty in the QMS and EMS implementation of the main contractor, as several organisations (often small companies) work simultaneously on one site.
- **Separate design and building**: compared to industrial production, traditional separation of the design and building process is a unique feature of a construction project which represents a special challenge for the contractor. This feature is eliminated only when “design-build” method is chosen as the project delivery method [21, 35]. When traditional delivery methods are used, the contractor has no influence upon the design, including the choice of materials and components, which may restrict the potential of his EMS.
- **Lack of environmentally sound materials and technologies**: often, the contractor is not able to properly identify and reduce his environmental impacts, as the
available database regarding materials and technologies is insufficient to establish a level of environmental soundness.

- **Lack of worker support**: the educational level of a large number of workers taking part in a typical construction project is usually low, therefore they may not recognise the importance of the environmental problems, nor be willing to participate in the actions required by the environmental management, as it takes their additional efforts.

- **Magnitude of costs related to EMS implementation**: implementation of an EMS, similarly to the implementation of a QMS, costs money. This expense may be viewed as unnecessary if general environmental culture in a certain sector/country is low, and there is no incentive from the government. Common sense and observation also allow pointing out that weak environmental culture among competitors and lack of governmental pressure are possible barriers.

- **EMS standards unsuitable for a construction**: this is again a barrier specific to the construction industry. Contractors may perceive general EMS standards as unpractical for use in construction due to its special characteristics.

- **Extensive documentation**: a construction project is a fairly complex as well as a dynamic process. Therefore any additional documentation required neither by the regulations nor by the contract may be viewed as unnecessary, and perceived as an obstacle to the implementation of the EMS.

- **No competitor starts first**: construction industry is highly competitive, and any additional cost generated within the company without visible financial gain, such as the cost of establishing the EMS, may be viewed as a factor of reducing the profit margin or the chance of winning a project.

### 2.9 ISO 9001

The set of norms ISO 9000 is a set of quality norms established by the International Organization for the Standardization (ISO) that can be applied in any kind of organizations (production companies, service companies, public administration...) [15].

Its implantation in these organizations, and despite involving an intense work, offers a wide quantity of advantages for its companies. Its main benefits are [15]:

- Reduction of rejections and disruptions in the production or service delivery.
- Increase of the productivity.
- Major commitment with the client’s requirements.
Continuous improvement.

This set of norms appeared for the first time in 1987, having as its main base a British standard normative (BS), though it did really start spreading from its version of 1994. With this more renewed focus, much more oriented to the management by processes, the version of 2000 was edited. Recently, and after having added some updates and clarifications, we achieve to the norm that is in force nowadays, the ISO 9001:2008, which is the principal norm of the set [15].

It is said that the quality system must demonstrate that the organization is capable of [15]:

- Providing a product or service that in a consistent manner meets with the clients’ requirements and the corresponding regulations.
- Achieving the customer’s satisfaction through the effective application of the system, including the prevention of non-conformities and the continuous improvement process.

The quality system model consists of 4 principles that allow the grouping in 4 interactive subsystems of quality management and that should be normalized in the organization [15]:

- Responsibility of the direction.
- Management of the resources.
- Realization of the product or service.
- Measurement, analysis and improvement.

The normative ISO 9001, elaborated by the International Organization for the Standardization, specifies the requirements for a quality management system that can be used for its application, for the certification or with contractual purposes [15].

The current version of the ISO 9001 dates from November 2008, so that is why it is referred to as the ISO 9001:2008 [15].

In an organization the quality management system has as its main base the quality manual, and it is completed with some additional documents as procedures, manuals, technical instructions, records and information systems [15].

Normally there is a quality manager in the company who will ensure the compliance of all this [15].
3 Objectives

3.1 INTRODUCTION

This section outlines the general objectives to be achieved with the present investigation.

In a previous chapter it has been described and analyzed the implementation of the EMS in construction companies, especially the ISO 14001 standard. The above study constitutes the theoretical framework needed for a better definition of the research, design and procedures as well as for a better interpretation of the results obtained.

3.2 GENERAL OBJECTIVE

Since in 1996 the ISO 14000 norms were published it has being circulating among the companies of the construction sector the implementation of EMS in accordance with these rules. As noted above, the implementation of EMS in the construction industry is relatively recent, and there are just few references and investigations relating to the introduction and operation of EMS in this sector.

The main drivers of establishment of these management systems in construction companies are related to market requirements as well as with the achieving of a more competitive position.

Specifically, the promoters of civil works have introduced into tendering an environmental approach, asking the contractor from the submission of a PVA to an EMS certification by a recognized body [19].

In this context the shortcomings highlighted by the customers and other stakeholders, together with the problems identified during audits, have constituted a source of vital information in order to consider the need to analyze the implementation of EMS in companies of the construction sector. Thus arises one of the general objectives of this study:

TO ANALYZE THE IMPLEMENTATION OF ENVIRONMENTAL MANAGEMENT SYSTEMS IN DIFFERENT EUROPEAN UNION COUNTRIES SUCH AS AUSTRIA, ITALY, CROATIA, SPAIN, AND ESPECIALLY IN THE REPUBLIC OF SLOVENIA, AS WELL AS THE BARRIERS THAT ARE FOUND BY COMPANIES AT THE MOMENT OF IMPLEMENTING THEM.
3.3 DERIVED OBJECTIVES

This study arose initially to analyze the evolution of Slovenia since 2006, when a similar study was carried out by the external tutor of the present investigation, Jana Šelih [56]. As time goes by we decided to expand this study in order to do a general analysis on the implementation of the EMS in European construction companies, being this the principal objective. Bearing in mind this, one derived objective of this study is:

• To analyze the evolution in the implementation of the EMS since 2006 to the present in the specific case of Slovenia.

In order to carry out such evolution it was necessary to separate the results for Slovenia from those of the rest of the countries, which enabled us to make a comparison between both cases, being the second derived objective the following:

• To do a comparative analysis of the results obtained for Slovenia and the rest of the countries, as well as commenting the differences or similarities that may appear.

The last derived objective emerged from the necessity of distinguishing the results of small and medium-size companies from those of large companies. It is important to be aware that the drivers as well as the barriers for EMS implementation are different for corporate companies and for the SMEs [3, 27, 56]. This difference was equally studied according to the typology of the company and depending if they were strictly construction companies or not:

• To analyze the differences in the implementation of the EMS according to the size and typology of the surveyed companies.
4 Methodology

4.1 INTRODUCTION

This section describes the methodology used to conduct the research that is the subject of this study. That is to say, the different stages of the investigation are described justifying the suitability and content of each one.

This is a descriptive research whose aim is to characterize a problem studying it in the most comprehensive and complete manner as possible, leaving for a later stage the search of the factors to which it is associated.

From the knowledge of the area under investigation there have been formulated specific questions that are intended to respond.

The description of section “survey as a research technique” (justification, field work and design of the questionnaire) and the section of “the surveyed sample” are especially long because of the importance they had in the development of this study. It is because of this same reason that we should also highlight the “results and analysis” section that we can find at the end of this chapter.

4.2 RESEARCH PHASES

The stages of the research that is being subject of this study have been:

• Knowledge of the State of the Art.
• Determination of research objectives.
• Methodological development of the research:
  - Determination of the proper techniques.
  - Design Survey.
  - Preliminary investigation.
  - Background research.
• Conclusions.

4.2.1 State of the art

During the phase of the state of art knowledge, it has been compiled all the information in relation to the environmental management systems (EMS) in construction companies and the ISO 14001 in this sector.

It was carried out a search and a reading of documents, studies, magazines, articles, etc. related to the mentioned issues.
During this phase we conducted a search in which the following databases were consulted:

- Library of the Faculty of Civil Engineering of the University of Ljubljana [11].
- World academy of Science [65].
- Dikul, digital library of the University of Ljubljana [10].
- UPCommons, digital library of Rector Gabriel Ferraté (BRGF) [60].
- European Commission [14].

4.2.2 Objectives

The determination of the objectives was carried out after reviewing the available information on the topic of this research and being familiarized with the specific characteristics of the works studied, trying to adjust those objectives to the real possibilities of data collection and testable reliability from the scientific point of view. Then, a general objective has been defined:

- To analyze the implementation of the environmental management systems (EMS) in construction companies in different countries of the European Union, as well as the barriers that are found by companies at the moment of implementing them.

During the course of this study it arose the necessity of justifying a sequence of data and, even more, an analysis on the particular case of Slovenia was carried out, so then three more objectives emerged:

- To analyze the evolution in the implementation of the EMS from 2006 to the present, in the specific case of Slovenia.
- To do a comparative analysis of the results obtained for Slovenia and the rest of the countries, as well as commenting the differences or similarities that may appear.
- To analyze the differences in the implementation of the EMS according to the size and typology of the surveyed companies.

The origin of the first objective deals with a previous study in which this same implementation and these same barriers were analyzed in 2006 by the external tutor of the present investigation, Jana Šelih [56].

Then, the second objective is a prolongation of the first one, since in order to analyze the evolution of the EMS in Slovenia it was necessary to separate the results obtained for this country from the results of the rest of the countries. Once this was
done, a difference in the results was observed, so that a comparison between the results for Slovenia and those for other countries was carried out.

Finally, the third objective comes from the necessity of justifying the second one, something that was done through an analysis according to the size and typology of the companies.

4.2.3 Methodological development of the research

In reference to the methodological development of the investigation, it should be said that this was known from the very beginning. Methodology has been mainly based on quantitative techniques (surveys) over a simple of companies of the European Union in 2013.

During this phase, the survey that has allowed the collection of all the necessary information to achieve the objectives was developed. The external tutor of this study facilitated the version of the survey that was sent in 2006 to the companies, so we decided to add certain questions but keeping always its original general structure in order to be able to do a comparison in this country. The only aspect that did not remain the same was the manner in which these questionnaires were sent to the companies, since instead of sending them as an attached document in the email that changed into a web survey, and therefore all questions had to be rewritten once more.

It was not needed an extensive preliminary investigation that allowed to find out if the questions that were asked and their objective could provide objective answers in accordance with the established objectives, precisely because a previous survey was done years before, though with a lower number of surveyed companies.

It was only when this survey was extended to more territories it was necessary to add a few more questions so that it was possible to separate the results according to the countries.

Subsequently, background research began by sending the survey to a representative sample of construction companies and manufacturers of building materials and engineering companies. In total, 135 questionnaires were sent to Austria, Croatia, Italy, Spain and very specially to Slovenia. The intention was to look for a sample of companies of the European Union. The choice of these countries was a personal decision taken together with the tutors of this project and looking for countries operating around Slovenia, except in the case of Spain, which was included for being the country of origin of the author of this study.
Once the answers were received the data obtained was processed and analyzed so that it was possible to interpret the results of the information collected.

**4.2.4 Conclusions**

This analysis, together with the theoretical framework and the experience of the tutors of this investigation, has led to different conclusions that have been described once the study was finished.

**4.3 THE SURVEY AS A RESEARCH TECHNIQUE**

**4.3.1 Justification for the selection of a survey as a research technique**

The survey can be used not only to carry out exploratory or descriptive investigations, but also to analyze and explain the existing relations between different and multiple variables. Hence, the adequate realization of a survey will make it possible that it answers to questions about the what, when, how, who and why of a specific reality [19].

To analyze, explain and describe the current situation regarding the implementation of EMS in European construction firms, manufacturing and engineering companies requires the implementation of a feasible research technique as the survey.

The survey may be the most appropriate procedure for the attainment of the objectives of this study, and in fact it was the method used in the previous study of 2006, being this the reason why a big proportion of the old survey has been used in the present study.

Once a survey has been selected as a research technique it is necessary to choose the type of survey that is going to be used depending on the manner in which the techniques for the collection of data are administered, that is to say, the face to face personal survey, the telephone survey and the survey by mail or web. For this investigation, and according to the criteria set out below, it has been considered as the most appropriate modality the web survey.

**Selection criteria**

- Nature of the issues addressed by the research: because of the issue that has been analyzed it has been necessary to ensure at all times the confidentiality of responses, and thus, the anonymity of respondents and the company they represent.
• Length and complexity of the questionnaire: the web survey provides greater flexibility over other modalities, that is to say, respondents have time to develop and review their responses and to consult before answering any questions. Furthermore, the survey is delivered to physically remote and busy people, with whom it is more difficult to maintain a long phone conversation and arrange a personal interview.

• Financial and human available resources: the territorial scope for the survey was different European countries. A personal interview is not feasible because there are geographical limitations to conducting the survey, since the population is scattered. What is more, the telephone survey requires more material resources, so that is why we have discarded personal and telephone surveys.

• Aspects related to the population to which the survey is addressed: the educational level of the survey population is high because respondents are technicians responsible environmental management system of works, so consequently self-administered questionnaires can be used. Finally, there is a correct and exhaustive listing of the addresses of the persons to be surveyed. All these circumstances warrant the conduction of a web survey.

It is because of all these reasons that ideas such as the telephone survey, personal and postal surveys were discarded, since they are slower and they offer a higher rate of non-response answers. Between the survey via email and the web survey we finally chose the last one because, as commented previously, it is the faster way of answering.

However this, it must be also highlighted that not only benefits can be applied to this kind of questionnaire:

• Web surveys are a very new and more complicated format for the interviewer, and that requires some computer knowledge to develop this type of survey and collection of responses. Despite being more complicated for the person doing the interview, we decided to provide the respondent with more facilities at the moment of answering the questionnaire.

• Personal inexperience in the elaboration of this kind of surveys, since it has been the first time that we created a questionnaire following this format, and so in order to do that we decided to use a web site specialized in these type of surveys.

• Despite the survey is anonymous, this is not always a positive aspect, since sometimes it is difficult to know who opens the questionnaire, if they are read or quickly discarded, at the same time they are very impersonals, which may cause
confusion or passivity in the respondent. In order to avoid this and before we sent the questionnaires we decided to do a previous work that is being described here.

4.3.2 Field work

With the only aim of ensuring a good rate of answers and avoiding such passivity that may arise from web surveys we decided to do a previous work that consisted of contacting with all companies before sending them the link with the questionnaire.

Firstly, we proceeded with an exhaustive search via internet to find the different email addresses of each selected company, so we looked for them in the companies’ web pages.

We did not want to send the link to general information email, but to specific persons so that the number of answers would definitely increase. In these specific cases where these specific emails were found we subsequently tried to contact directly with the technician. Then, I would introduce myself as a student doing a final degree project, and they would equally be informed about the topic of my study and its objective, as well as my wish to be facilitated the exact and adequate person to whom the questionnaire could be sent. Once the contact of the responsible person on environmental issues was obtained, then he/she was explained all the points mentioned above, apart from reinforcing the importance given to collaboration and commitment with this project and not forgetting the fact of the anonymity of the survey, both at a personal level and in reference to the company that is being represented. The last step was to send the link with the survey.

In many cases it was impossible to find the specific addresses of technicians, top managements, secretaries, etc. but just a general email of information or suggestions, or maybe forms that had to be filled in online. For this case the procedure explained above was repeated asking specially for a specific email of the best-positioned person in order to send the questionnaire.

In those cases where no answer was provided the process was repeated three or four more times, which sometimes ended in a positive result. In general, and according to experience, we can say that to obtain the right contact in large companies is even more difficult since forms need to be firstly filled in the specific web page of the company and a response is not always obtained. By contrast, in small and medium-size companies this contact seems to be easier to obtain, though the problem is that their
participation is lower since generally participants don not tend to answer this kind of questionnaires if they are not familiarized with these issues. That is, normally not having adopted the certificates means that the participation is more difficult and, as we will see later on, the SMEs have a lower percentage of implementation of these certificates, and more specially the ISO 14001.

The questionnaire was sent to each technician by copying the link where they were directly redirected to the web survey. Together with the questionnaire it was also attached:

- A brief introduction highlighting the aim of the investigation.
- The author’s personal contact in case they required more information, they needed to solve any doubt or suggest anything.

During the whole process the results obtained have been monitored with the aim of ensuring the maximum participation. As the last measure those companies that, despite having being sent the email with the link several times continued without responding, were directly sent the link of the survey to the general email.

A total of 54 non-answered questionnaires were received from a total of 135, that is to say, a 40% of abstention. From these 54 we have to point out to 2 companies that were bankrupt, 22 questionnaires that were open and closed without being answered and 30 that were not even open. Because of the reasons that were previously mentioned, it seems to be more obvious that the 30 questionnaires that were answered come from large companies and the 22 that were not from small and medium- size companies.

4.3.3 Design of questionnaires

In this phase of the investigation three procedures have been carried out in order to optimize the results of the study.

Firstly, we have analyzed the information obtained in the chapter corresponding to the state of the art (chapter 2). Secondly, it has been analyzed the quality of the questionnaire through the experience of the tutor of this study and the answers obtained in the year 2006. As a result of this phase it was designed a definite survey that would be used for the development of the investigation.

We started from the questionnaire of 2006 that was provided by its author, though it had to be rewritten and some aspect changed significantly due to the modification in the chosen format (web survey instead of email), which culminated with the addition of some new questions according to the new international scope of the questionnaire.
A new thematic block was created called “introduction”, where two more questions were added together with a brief presentation of the author of the study, as well as a description of its objective. What is more, because of the new scope of the investigation we decided to do two questionnaires, that is, two identical in content versions which differed only in the language. One questionnaire in Slovene was sent to companies that worked in this country and another one in English for the rest of the companies that did not work in Slovenia.

Once we decided these points and after the objectives of the investigation had been revised, we have made a distinction between the following areas, each of which corresponds to one thematic block of the questionnaire:

- Part 1: Introduction
- Part 2: General aspects
- Part 3: Quality
- Part 4: Environment

A brief introduction has been added before the first part of the questionnaire in the sections devoted to the study of results and interpretation and analysis, which corresponds to chapters five and six, respectively. In this introduction it has been described and analyzed the results corresponding to the number of obtained responses in the questionnaire.

In reference to the order and disposal of the questions in the survey, the main intention has been to make it as easy as possible for the respondent. The location of the questions in this survey has been done according to the following criteria:

1) Group questions with similar content.
2) In each thematic area we have tried to provide an order from the least to the most committed questions.
3) Questions in relation to demographic variables have been situated at the beginning of the questionnaire for being general and easier, so that the person who is being surveyed contributes more efficiently with the questionnaire and the objective of the investigation.
4) We have tried to avoid the interviewer from following complex indications in order to answer the questions.

From these criteria and suggestions we observe that:

In the introduction, as it was previously mentioned, a brief presentation of the author together with the description of the objectives, the aim of the study and a few
questions were provided. The main objective of this specific part of the investigation was to know the country of origin of the company.

In the second part, the general one, three questions referring to different aspects of the companies appear, being the main objective to get to know the typology and size of the company.

The part devoted to quality has nine questions, and through it we intended to know the companies’ position regarding the adoption of a quality management system, specifically the ISO 9001, and the main reasons for establishing this QMS specifically. For those companies that did not have at their disposal ISO 9001 they were asked about their intentions for the future and the reasons that may have provoked such decision. This part is very important for a future study of part number 4 of the investigation, since obtaining this certificate is in many cases the first step for the adoption of ISO 14001.

Part 4 is in relation to the environment and it can be considered the most important and the one which carries more questions in this study, and in fact all the previous parts are conducted in a way that they can be applied for the analysis of this part. It has a total of twelve questions from which we can obtain several objectives.

Firstly, get to know the company’s position regarding the environmental policies, the environmental management systems and more specifically the ISO 14001. Secondly, companies with a favourable position in these policies were asked about the areas where they were more focused on, as well as the barriers they found when deciding to implement the ISO 14001. Finally, those companies that did not have any EMS were asked about their intentions for the future and were equally redirected to the questions referring to the barriers that they may perceive when establishing the ISO 14001.

Because of the inexperience in this kind of format this step remained complicated at the very beginning of the investigation, since we did not know too much about the elaboration of a web survey, so we opted for asking people who were more in contact with this kind of issues: computer technicians, telecommunication engineers, etc. who provided me with this kind of help, apart from providing me with another software as the Google, docs. After analyzing all the possibilities we finally opted for the services that “e-encuestas” offered in their web site, www.e-encuestas.com [17], where they offer their registered clients the option of making surveys for free, as well as creating a direct link for them and the compilation of results.
Firstly, some questions were redacted and a pilot test was done without providing any format in order to check if the system worked. The test resulted to be positive since apart from the fact that the participants of this test received and could open the surveys perfectly, their administrator received without any problem the results. What is more, it was even possible to know the number of questionnaires that had been open and then closed without being answered.

By doing this we discovered that the software that was being used allowed various types of questions, though in this study we used three main types: one or more option questions, open questions and numerical valuation questions.

Close questions or one or more option questions are the ones that have a major representation in this questionnaire because, in general, they are considered to be more reliable and effective than the rest of the questions. In addition to this, they facilitate the later categorization and analysis of the answers, so whenever it was possible, this was the option chosen.

When trying to obtain unanticipated answers that were not primarily suggested in the questionnaire, questions were raised in a way so that the interviewers had the possibility of responding with their own words. As examples of this we can point out to questions 3, 8 and 24, where the major percentage of abstention was observed.

The last type of questions that was used were questions were a series of aspects of major or minor importance according to the necessities of each company were evaluated numerically. These questions are very useful at the moment of collecting the answers and doing the analysis, and in them we can enumerate the most important and less important aspects of the different respondents that have been surveyed. Some examples of this type of questions are 11, 13, 16 and 26.

Once the functioning of the software was checked and the chose of the type of questions was made, we gave format to the survey by, firstly separating according to the thematic blocks, giving colour to the headings, adding a percentage bar representing what has already been answered in the survey, etc. The format that was going to be used for each question was chosen, since the software allowed the possibility of putting questions horizontally, vertically, in a deployable manner, etc. In most of the questions the chosen format was that of vertical questions without being deployable, for being easier to the respondents. For questions of numerical valuation we opted for a double entry matrix in which there were represented in rows reasons/ barriers/ areas and then in columns we find the punctuation arranged from least to most, where 1 meant the
maximum punctuation and 5 the minimum, though in some cases it was 7 the number that referred to the minimum punctuation. In this kind of questions respondents were also given the option of not answering, that is N/A (no answer). All these needed explanations regarding the way of answering the questions were always provided to the respondents.

When the questionnaires were prepared to be sent we decided to do something else which consisted of, due to the success in the development of the survey, hiding some questions depending on the answer provided by the interviewer so that he could move from one to another quickly and avoiding always changes of the thematic block. These changes or jumps were automated to facilitate the work to respondents, so that they did not see the extension of the survey and they did not have to jump from question to question manually, since sometimes seeing a survey in its entirety and its extension is the main cause of the lack of motivation among respondents when answering it.

With this automated process we did again carry out a pilot test where some problems regarding those jumps and changes were identified, so it was not until these problems were solved that we considered that the web survey was prepared to be sent. However this, this process had to be repeated twice according to the two existing versions of the questionnaire, one in English and a second one in Slovene. The corresponding links are the following:

English questionnaire: http://www.e-encuesta.com/answer.do?testId=BO7XSCWtmLo=
Slovenian questionnaire: http://www.eencuesta.com/answer.do?testId=3xNvD4eHwZg=

In the part corresponding to “Annex I” both questionnaires are attached, and it is in “Annex II” where the version from 2006 can be seen.

Apart from the results that have been previously mentioned in the different phases from the design of the web survey we conclude that:

• The language and concepts that have been used are understood by the interviewers.
• The results obtained confirm that the order of questions allows an adequate development of the questionnaire.
• The response time of the questionnaires can be estimated of around one week or less, being the last day for receiving answers the 1st April 2013.
4.4 THE SURVEYED SAMPLE

The purpose of this research, and therefore of the survey, is to analyze the functioning of the EMS applied in different European manufacturing, engineering and construction companies.

In order to select the population the following considerations were taken into account:

- We have considered different types of civil engineering firms (roads, railways, hydraulic, airports, housing developments, etc.).
- We have equally considered material production companies and engineering companies for the development of this study.
- The investigation area is very wide, so we decided to narrow this study to a total of 5 from the 28 countries that form the European Union. We considered Croatia as another member, since it will be officially part of the European Union the 1st July 2013.
- The chosen countries have been Austria, Croatia, Italy, Slovenia and Spain.
- The size of companies according to their volume of workers. Our aim was that there was not a big inequality in the percentage of participation of large and small or medium size companies.

For the selection of the different companies that have participated in this study we have made use of the following sources:

- Internet; the companies’ web pages, sites specialized in this sector, as well as different studied and data of this sector in each country [16, 42, 44, 52, 55].
- Chamber of Commerce and Industry of Slovenia [4].

As a result of this process it has been defined the target population of the study, which consists of one 135 companies.

In every section it must be highlighted a relevant difference between Slovenia and the rest of the countries both for the size of the sample, its typology and the size of the companies. For each case we have worked differently, as we shall see below.

The present investigation took place during a temporal stay in Slovenia according to the European Erasmus exchange program, and it is this the reason why at the very beginning the study was supposed to be focused only on Slovenian firms. Because we had at our disposal a previous study from 2006 [56] we wanted to observe the progress
that this country had gone through in these years in reference to the implementation of the EMS.

After several meetings with the tutors of the investigation we finally decided to expand the scope of the study to a European level, since not many large multinational companies can be found in Slovenia. Then, we did also try to observe any relevant differences between this country and the rest in reference to the implementation of the EMS, for even if each country has its own laws all of them are framed in the same legislative context, which is the one referring to the European Union.

This meant the change of the main objective of the investigation, which finally was the study on the implementation of the EMS in construction companies. Apart from this, two more objectives were taken into account: studying the difference between Slovenia and the rest of the countries, and the evolution of this former country since 2006. Hence, during the study and as it had been planned with anteriority we observed an important difference regarding the size and typology of companies, so we did an additional analysis according to this specific case. From here the last objective of the present study emerged, that is, to analyze the difference in the implementation of the EMS according to the size and typology of the company.

The major problem we found was in relation to the big extension of the European Union, formed by 27 (28 from the 1st July 2013 on) and with 4,376.780 km² [14], which made it impossible to represent the entirety of its surface. Another derived problem was the wide variety and quantity of languages that are spoken. Just Spain and of course Slovenia were from the very beginning chosen on purpose for being the former the country of origin of not only the author of this study, but also of the main tutor. The rest of the countries (Austria, Croatia and Italy) were selected only for being adjacent to the later one. Then, the most apparently complicated country was Croatia because right now it does not form part of the European Union, but because of its soon inclusion in the European Union we finally added it in our study.

Once the countries that were going to be the object of study were selected we commenced the search of companies that were going to participate in the investigation, being this the precise part in which the difference between Slovenia and the rest of the countries has its origin. The reason that explains this is that, because it was going to be analyzed the difference or similarity of this country in comparison to the rest of them as well as its evolution, Slovenia needed an important representation of at least the same number of companies as the sum of the rest of the countries.
The fact of being in the necessity of doing a deeper list of participants in this country, where we finally sent a total of 77 questionnaires, provoked that the sample of mentioned companies was slightly different. Our objective was to send the questionnaire to as many companies as possible, since even this number would not be very elevated. The consequence of this was that for this case the number of SMEs and different typology companies was bigger, that is to say, the percentage of companies devoted to material construction and engineering companies is far superior to that of the rest of the countries. The explanation that may justify this has relation with the small size of Slovenia, with an approximate population of 2,000,000 people in a surface of 20.253 km² [14], which made it necessary to include companies that were not 100% construction companies, but that belong to this sector and have an important influence in the processes of the construction industry. This was done without forgetting the fact that the real aim of the study was to find the largest percentage in construction companies.

We did not do any kind of separations in the rest of the countries, since we did not have to analyze the evolution throughout time, so we did a joint analysis with the idea of sending approximately 15 questionnaires per country, which made a total of 60. Finally this number changed to 58. The sum of all questionnaires is similar to that sent to Slovenia, but if we analyze everything per country and having chosen only 15 companies in each one it is easier to find large multinational companies devoted exclusively to construction. With the aim that the two samples were similar up to a point we did not only send the questionnaire to this type of companies in the case of the European countries, but we did also include the SMEs and the material production and engineering companies, though in a lower percentage, and always bearing in mind that the majority of the companies were exclusively construction companies.

In Slovenia the percentage of SMEs is 63%, while for the rest of the countries this percentage changes to 44%. The percentage of exclusively construction companies has been major, as it was pretended, being in Slovenia the 64% and in other countries 73%. This difference especially in the size of the companies [3, 27 56] made it easier to identify another divergence in the results of Slovenia and the rest of the countries, so we decided to analyze separately SMEs and large companies, being this analysis one of the objectives of the study.

Because of such divergence in the number of sent questionnaires in each country the searching methods were very different for each case. In Slovenia we had to do a
deep search firstly via internet and then this was followed by a direct contact with different organisms such as the Chamber of Commerce and Industry of Slovenia [4]. In this case our purpose was to send as many questionnaires as possible, since anyway it would not be a very elevated number according to all the conditions described previously: demography and surface.

On the contrary, in the rest of the countries and given the fact that it was a reduced sample of companies, 15, this search was much easier regarding their population and surface. It is thanks to previous knowledge and a search through the internet in various specialized web pages, studies or companies’ websites that enabled us to select a list of participants for our investigation. The only consideration that was taken into account referred to our objective of distributing the questionnaires. The idea was that not only large construction companies participated in the study, but also SMEs and materials production and engineering companies, and objective that was successfully achieved, as we can observe from the previous percentages.

Once the final list of participants was elaborated and the survey was finally defined another problem arose: the language.

It is evident that the language remains a very important resource to motivate participation and collaboration of the technicians that were surveyed, and so we were profoundly supporting the idea of contacting the companies in their mother tongue whenever it was possible. However, this was impossible in all cases because of the lack of knowledge of the languages that were to be used, and so it was not possible to explain and define the objectives of the study and the elaboration of the questionnaires in other languages. Because the scope of application of this study is so extended and dispersed we decided to use English, which is the most important and used language in the business world. In fact, in most of the countries the representation is reduced, around 15 companies, that it did not worth to spend time on translations and redaction of new questionnaires.

The only exception was Slovenia according to its representative participation in this study with 77 questionnaires, which made that for this specific case the whole process was translated into Slovene. All this was possible thanks to the help of the external tutor of this project, who did not only translate form English to Slovene, but she did also interpret the texts that were written in Slovene. What is more, the facts that two questionnaires were created and that it was necessary to differentiate the results between this country and the rest of them facilitated the collection and treatment of these results.
The Slovenian questionnaire was exclusively sent to companies of this country, while the English one was sent to the rest of the countries even if both versions were identical in content.

Once the method used for the survey was chosen (web survey) and perfectly designed, and once the field work was elaborated with a list of companies and contacting specifically with the better positioned technicians to be surveyed, we were prepared for the next step, that is, the launch of the two versions of the questionnaire through a link. This new process started at the end of January 2013, and we established a deadline to receive answers until the 1st April 2013, that is approximately two months before the delivery of this investigation. This time was enough to elaborate the analysis and conclusions of the present study.

4.5 RESULTS AND ANALYSIS

4.5.1 Results

For the collection of answers we created a series of tables with the Microsoft EXCEL program, an election that is justified according to the possibility that it offers of representing graphically the results. In Annex III all the tables and graphics of the obtained results are attached.

On the website “e-encuestas” [17] itself we are allowed to observe questionnaire per questionnaire or download a list of global results. For the precise case of this study we had to check each questionnaire, since a division of the results was to be done.

Having the objectives defined this compilation was done in three different columns, being one exclusively devoted to the answers of the Slovenian version of the questionnaire. In the second column we can find the results of the rest of the countries, and then in the last column we find the sum of all the results, both from Slovenia and other countries.

These three columns that are described here allowed us to study the different objectives that have been defined for this study:

- The global column in which all the results are represented allowed us to analyze the main objective of the present investigation, that is, the implementation of the EMS in European construction companies, as well as the barriers they may find when implementing these systems.
- The column referring to the Slovenian questionnaire allowed us to analyze the evolution of this country from 2006 to 2013.
• The column that represents the English questionnaire was used to establish the existing differences between Slovenia and the rest of the countries.

Once the results for each case were written numerically we did the same but this time writing them in percentages by creating three columns and working always with two decimals. Despite in section number 5 all the tables have been attached, we can observe here an example of one of them taken from the original EXCEL.

<table>
<thead>
<tr>
<th>EN</th>
<th>SL</th>
<th>TOTAL</th>
<th>% TOTAL EN</th>
<th>% TOTAL SL</th>
<th>% TOTAL</th>
</tr>
</thead>
<tbody>
<tr>
<td>5</td>
<td>13</td>
<td>18</td>
<td>15.63%</td>
<td>26.53%</td>
<td>22.22%</td>
</tr>
<tr>
<td>9</td>
<td>18</td>
<td>27</td>
<td>28.13%</td>
<td>36.73%</td>
<td>33.33%</td>
</tr>
<tr>
<td>8</td>
<td>14</td>
<td>22</td>
<td>25.00%</td>
<td>28.57%</td>
<td>27.16%</td>
</tr>
<tr>
<td>5</td>
<td>4</td>
<td>9</td>
<td>15.63%</td>
<td>8.16%</td>
<td>11.11%</td>
</tr>
<tr>
<td>5</td>
<td>0</td>
<td>5</td>
<td>15.63%</td>
<td>0.00%</td>
<td>6.17%</td>
</tr>
</tbody>
</table>

Figure 3. Example of a table used for the collection of results.

This format has been used in most of the questions of the survey and especially in close questions (or uni/multi optional questions). This type of response is not only the most comfortable one for the person who is being interviewed, but also for the person who interviews, since it is easier to write down the results in the tables.

As it has been previously mentioned, in the questionnaire there are three different types of questions; the open ones, numerical valuation questions and close questions, which have already been defined.

In the case of open questions this collection was done by writing down in the form of a list the responses obtained checking questionnaire per questionnaire. Specifically, there are three open questions in this questionnaire; number 3, 8 and 24. We have to highlight the fact that this kind of question was the one which received a higher percentage of abstention, and very specially questions number 8 and 24.

Then, referring to numerical valuation questions we have to point out to a more complicated collection, since two different tables had to be created for each case, that is one for Slovenia, another one for other countries and the last one for the sum of Slovenia and the rest of the countries, which meant a total of six tables for each question. Everything was collected in cross tables where the total number of 1 (major punctuation), 2, 3, 4 and 5 (though in question 16 this goes further on to 7 punctuations) were written down for each question, and so this tables were repeated for the percentages.
Here we can observe an example of the original table for the totality of the results:

<table>
<thead>
<tr>
<th>SL</th>
<th>1</th>
<th>2</th>
<th>3</th>
<th>4</th>
<th>5</th>
<th>N/A</th>
<th>TOTAL SL</th>
<th>% SL</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>9</td>
<td>15</td>
<td>6</td>
<td>5</td>
<td>13</td>
<td></td>
<td>45</td>
<td></td>
</tr>
<tr>
<td>7</td>
<td>15</td>
<td>12</td>
<td>3</td>
<td>0</td>
<td>12</td>
<td></td>
<td>45</td>
<td>14.26%</td>
</tr>
<tr>
<td>23</td>
<td>10</td>
<td>11</td>
<td>2</td>
<td>2</td>
<td>1</td>
<td></td>
<td>12</td>
<td>4.59%</td>
</tr>
<tr>
<td>9</td>
<td>12</td>
<td>11</td>
<td>6</td>
<td>0</td>
<td>11</td>
<td></td>
<td>36</td>
<td>18.37%</td>
</tr>
</tbody>
</table>

We observe that there are four questions of this kind in our study; questions 11 and 13, where reasons are punctuated, question 16, where areas are punctuated and finally 26 where the barriers that make it more difficult to establish the ISO 14001 are evaluated.

Throughout the development of this study it arose the necessity of writing down separately some of the answers of the questionnaire according not to the version of the questionnaire (Slovene or English), but to the size and typology of the companies. In order to do this we had to check each questionnaire once more. These last auxiliary tables helped us with the analysis of our last objective in this investigation:

- The analysis of the results according to the size (number of the companies’ workers, distinguishing between SMEs and large companies) and typology of the companies (construction and non construction companies).

The distinction according to the size of the companies was done by taking the results of question number 4, where the respondent was asked about the number of employees of his/her company. We considered companies with 0 to 250 workers as small and medium size companies, while those with more than 250 workers have been considered as large companies [56].

The distinction according to typology was done by taking the results of question number 3, where the respondent was asked about the activities of his/her company and the approximate share of individual activities. We considered that companies with a percentage of construction equal or major to 70% were construction companies, while lower percentages at this respect implied that companies were considered non construction companies.
This analysis was not done for the totality of the answers, since it was done in order to justify some differences that were observed between Slovenia and the rest of the countries. Specifically, we analyze four aspects in relation to the size of the companies: companies with the ISO 9001, companies with an environmental policy, companies with any EMS, and finally companies with the ISO 14001.

With regard to the specific case of the results that were obtained according to the typology we have studied three answers, that is those that make reference to the EMS, as we observe in questions number 15 and 18: companies with an environmental policy (question number 15), companies with any EMS and finally companies with the ISO 14001 (both in question number 18).

Here 2 examples of the original EXCEL are shown:

Figure 5. Example of a table used for the collection of the results according to the size of the companies.

<table>
<thead>
<tr>
<th>Companies with ISO 9001</th>
<th>Yes</th>
<th>No</th>
<th>Total</th>
<th>%</th>
</tr>
</thead>
<tbody>
<tr>
<td>SMEs</td>
<td>35</td>
<td>10</td>
<td>45</td>
<td>77.78%</td>
</tr>
<tr>
<td>Big companies</td>
<td>34</td>
<td>2</td>
<td>36</td>
<td>94.44%</td>
</tr>
<tr>
<td>Global analysis</td>
<td>69</td>
<td>12</td>
<td>81</td>
<td>85.19%</td>
</tr>
</tbody>
</table>

Figure 6. Example of a table used for the collection of the results according to the typology of the companies.

<table>
<thead>
<tr>
<th>Companies with an environmental policy</th>
<th>Yes</th>
<th>No</th>
<th>Total</th>
<th>%</th>
</tr>
</thead>
<tbody>
<tr>
<td>&gt; 69%</td>
<td>36</td>
<td>13</td>
<td>49</td>
<td>73.47%</td>
</tr>
<tr>
<td>&lt; 70%</td>
<td>20</td>
<td>12</td>
<td>32</td>
<td>62.50%</td>
</tr>
<tr>
<td>Global analysis</td>
<td>56</td>
<td>25</td>
<td>81</td>
<td>69.14%</td>
</tr>
</tbody>
</table>

We have also added at the beginning of the chapter focused on the results a few tables where the percentage of answers that were obtained for each questionnaire is shown. Once all the tables were created we continued with the analysis of the obtained results.

4.5.2 Interpretation and analysis

This investigation is based on the compilation, statistical processing, analysis and interpretation of the results that were obtained from the survey that was sent to different construction, material production and engineering construction companies of Europe.
The analysis corresponds to section number 6 of the present study, and it was done by using graphics that were obtained from the different tables that were created, being all of them attached in section 5 of this document.

Our first decision had to do with the type and format of the graphic. It was not until lots of tests were done that we finally decided for the selection of clustered bar charts for close questions and stacked column charts for numerical questions. In the case of open questions and because of the wide variety of answers from different precedence that were received it was not possible to represent results graphically, so we finally did a written analysis for each one, directly.

It is well known that the bar graph (both clustered and stacked) is very useful at the very moment of understanding the results, since visually speaking they stand out quickly and much more in the case of representing percentages or total quantities of answer.

Once established the type of graphic we were thinking on the idea of representing the quantity of answers obtained in numbers, in percentages or both, but because there were several bars for each graphic we decided to represent the results only in the percentage form. In this representation we used percentages with two decimals, except for some specific cases in which because of the accumulation of results we opted for a solution without decimals. Furthermore, we decided to represent in the coordinate axis the percentage from 0 to 100%, and in the abscissa axis the different possible answers. In order to observe the quantity of answers for each question we would have to give a look to tables in section number 5.

The representation of results was elaborated once the type of graphic was defined. Because of the fact that several objectives had been defined we had to create a minimum of two graphics for each question, that is two graphics for close questions and three for numerical questions.

In close questions the first graphic represents two clustered bars for each possible answer, that is to say one for Slovenia (results obtained from the Slovenian questionnaire) and next to it another one for the rest of the countries (results obtained from the English questionnaire). The second graphic had three grouped columns in which the two previously mentioned columns were added a third one with a global result that refers to the sum of the answers obtained from both the Slovenian and the English questionnaires. Even more, in this last graphic it has been added a legend with the specific percentages for each case so that their lecture was facilitated, since in some
graphics the accumulation of data may provoke ambiguity when trying to understand their meaning.

In order to provide more facility at the moment of showing the results and to avoid confusion we did always follow this methodology: firstly, we exposed the two clustered bar graphic, and then the graphic with three grouped columns. Furthermore, we kept the same order of bars and colours, which means that the bar that represents the results for Slovenia, in green colour, does always go first. Next to it the results of the rest of the countries are represented in a blue bar. In the case of the graphic with three grouped columns it represents the global results in a purple bar.

Here we can observe an example:

![Clustered bar chart example](image1)

Figure 7. Example of a clustered bar chart used to represent the results for Slovenia and the rest of the countries.

![Clustered bar chart example](image2)

Figure 8. Example of a clustered bar chart use to represent the global results together with the specific results for each questionnaire.

In the case of numerical questions three graphics had to be created, since this kind of questions included multiple choice answers, which means that when representing
them in stacked bars they mixed too much and results were not easily understood. The solution was to create one graphic for the case of Slovenia, another one referring to the rest of the countries and a last one for the sum of the results.

As in the case of close sentences the order did always remain the same: results for Slovenia, results for other countries and then global results. It was also maintained the design of the graphics, which was the following:

Each stacked bar is represented over its 100%, and what is represented in this bar is the percentage of punctuation that has obtained each one of the possible answers that have been suggested. 1 does always represent the highest punctuation, and it is situated at the beginning of the abscise axis followed by the percentages referring to punctuation 2, 3 and 5 (in some cases 7), which represent the lowest punctuation. They are organized in an ascending and vertical order.

In this specific type of graphic, and because there is a minimum of five different percentages in each bar, which goes up to seven in question number 16, a mix of colours was produced. In order to look for a solution for this issue we decided to associate punctuations 1 and 2 with wood and water fillers, respectively, with the aim of facilitating the lecture of the results, visually speaking. In both cases we have avoided dark colour that may have obstructed the correct understanding of the percentages.

Here we can observe an example:

![Figure 9. Example of a stacked bar char used for representing numerical questions.](image-url)
There were two graphics were more clustered bars from the ones defined previously had to be added. They are two graphics where temporal and permanent locations of the companies are represented, as well as the percentage of participation of each country in this study. In this last percentage it appears six clustered bars, one for each country and a last one with the global participation.

In the first case twelve and eighteen bars were represented (see question 5 in the analysis), but these two are isolated cases that do not follow the format that has been described with anteriority in which respect to the colour of the bars.

With the tables and the graphics that were created we started with the interpretation and analysis of results.

**Interpretation**

The interpretation was done question by question, as opposed to what was in the analysis. Apart from the 26 questions of the survey we did also interpret the results regarding the participation in our web survey, as well as the graphics that represent the size and typology of the companies.

For each question we have attached its corresponding graphics (two or three), one under the other with the corresponding interpretation, which consists of describing the data that appeared in the graphics. As opposed to what happened in tables and graphics all percentages all rounded in order to work without decimals.

The order of this interpretation for each question is always the same:

- Global description (purple column).
- Comparison between Slovenia and the rest of Europe.

**Analysis**

The analysis is not done question by question, since we have a total of 26 and not all of them have the same importance, so the solution that we adopted was to provide an analysis at the end of each thematic block. Then, we did a general analysis of that part according to our objectives for that block specifically where, as in the interpretation, we worked without decimals.

The order remains always the same:

- Analysis of the global results.
- Comparison between Slovenia and the rest of Europe.
- Evolution of Slovenia since 2006 [56].

As we have described previously, we have 4 thematic blocks with different objectives. Firstly, in the introductory part we intended to know the precedence of the
companies, and then, in the 2nd block (“general”) the size and typology of the companies. In block the 3rd (“quality”) our aim was to know those companies with the ISO 9001 and the reasons for establishing it or not, and finally in our last block corresponding to “environment”, the thicker one, our objective has been to analyze the implementation of the EMS in the construction industry. This global analysis at the end of each block takes into account those objectives by putting special emphasis on the most relevant questions of each part.

All this procedure is repeated throughout the study, except in questions number 8 and 24 in which, because of being open questions with a low percentage of responses, we decided to do the analysis directly.

Apart from these four analyses corresponding to the 4 thematic blocks of the survey this investigation does also have a few more important analyses, which makes a total of six.

The first one, which is not associated to any thematic block of the survey refers to the participation of the companies in our study, and it is done and the beginning of section 6. The sixth and last analysis is done at the end of section 6, and it represents the analysis that comes from the justification of our last objective of this study, that is, the analysis of the EMS according to the size and typology of the companies that have been surveyed. At the end of chapter 6 we created a specific section called “auxiliary graphics” in which we continue with the same methodology: interpretation and analysis.

Once the analysis is finished and with the gained experience throughout the investigation and thanks to the tutor, we wrote the conclusions of this investigation.

4.6 SUMMARY

The steps that we have followed throughout this study have been:

1) Knowledge of the state of art; EU policy and EMS.
2) Establishment of the objectives.
3) Development of the investigation:
   3.1) Web survey.
   3.2) Design of the questionnaire.
   3.3) Selection of the sample to be surveyed.
   3.4) Field work.

All this had a duration of approximately 2 months after which we continued with:

1) Compilation of the obtained results.
2) Interpretation and analysis.
3) Conclusions.

These 2 last points had a duration of approximately 2 months, too.
5 Results

5.1 INTRODUCTION

In this chapter it will be collected the data obtained from the surveys that were conducted to construction, manufacturing and engineering companies of many different countries in Europe. In Annex III all the tables are also attached.

The collection and processing of the survey was carried out in a manner that has remained, at all times, the anonymity of respondents.

The responses have been downloaded individually through the internet portal above (www.e-encuesta.com [17]), which allows managing these surveys. Once downloaded, the values obtained have been introduced in the tables that appear in this section.

For the creation and calculation of the different tables that are included in this section we have used the Microsoft Excel program, and worked with two decimals.

This chapter shows the statistical treatment of the data, which for each question includes:

- The preparation of the tables with the number of responses for each question.
- The statistical calculation of percentages for questions that involve a numerical evaluation.

At the end of this chapter a subsection called “auxiliary tables” has been added with this same format. These tables (from number 30 to number 38) do not have any specific questions of the questionnaire associated to them, but they have been used to create some graphics that have been attached in the following section (interpretation and analysis of the results), as well as to justify some results that we have obtained in our study.

This first table shows the number of companies that have participated in the development of the study, which has been a total of 135. As discussed in the previous section, there are two versions of the survey, one in English and one in Slovene.

<table>
<thead>
<tr>
<th>Country</th>
<th>Number of questionnaires sent</th>
<th>Slovene questionnaire</th>
<th>English questionnaire</th>
<th>Number of questionnaire answered</th>
<th>Percentage</th>
</tr>
</thead>
<tbody>
<tr>
<td>Slovenia</td>
<td>77</td>
<td>77</td>
<td>0</td>
<td>49</td>
<td>63.64%</td>
</tr>
<tr>
<td>Austria</td>
<td>16</td>
<td>0</td>
<td>16</td>
<td>11</td>
<td>68.75%</td>
</tr>
<tr>
<td>Croatia</td>
<td>13</td>
<td>0</td>
<td>13</td>
<td>7</td>
<td>53.85%</td>
</tr>
</tbody>
</table>
Table 2. Number and percentage of responses for each country according to the different types of questionnaires.

<table>
<thead>
<tr>
<th>Questionnaire version</th>
<th>Number of questionnaires sent</th>
<th>Number of questionnaires answered</th>
<th>Percentage</th>
</tr>
</thead>
<tbody>
<tr>
<td>Slovene</td>
<td>77</td>
<td>49</td>
<td>63.64%</td>
</tr>
<tr>
<td>English</td>
<td>58</td>
<td>32</td>
<td>55.17%</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td><strong>135</strong></td>
<td><strong>81</strong></td>
<td><strong>60.00%</strong></td>
</tr>
</tbody>
</table>

Table 3. Number and percentage of responses for each questionnaire.

Of the 54 unanswered surveys a total of two companies were in a state of bankruptcy. Another 22 questionnaires have been opened by the companies, but left in blank or half answered, so the results have not been taken into account. The remaining 30 surveys were not answered at all.

5.2 PART 1 WEB SURVEY: INTRODUCTION

Question 1. Country/ies where the company works.

<table>
<thead>
<tr>
<th>Country</th>
<th>Number</th>
<th>Percentage</th>
</tr>
</thead>
<tbody>
<tr>
<td>Slovenia</td>
<td>50</td>
<td>59.52%</td>
</tr>
<tr>
<td>Austria</td>
<td>11</td>
<td>13.10%</td>
</tr>
<tr>
<td>Croatia</td>
<td>7</td>
<td>8.33%</td>
</tr>
<tr>
<td>Italy</td>
<td>9</td>
<td>10.71%</td>
</tr>
<tr>
<td>Spain</td>
<td>5</td>
<td>5.95%</td>
</tr>
<tr>
<td>Other</td>
<td>2</td>
<td>2.38%</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td><strong>84</strong></td>
<td><strong>100%</strong></td>
</tr>
</tbody>
</table>

Table 4. Number and percentage of the country where companies operate.
Question 2. What is your position in the company?

<table>
<thead>
<tr>
<th>Position</th>
<th>Slovenian companies</th>
<th>European companies</th>
<th>Global analysis</th>
<th>%Slovenian</th>
<th>%European</th>
<th>%Global</th>
</tr>
</thead>
<tbody>
<tr>
<td>Top management</td>
<td>11</td>
<td>3</td>
<td>14</td>
<td>22.45%</td>
<td>9.38%</td>
<td>17.28%</td>
</tr>
<tr>
<td>Responsible for environmental management</td>
<td>6</td>
<td>12</td>
<td>18</td>
<td>12.24%</td>
<td>37.50%</td>
<td>22.22%</td>
</tr>
<tr>
<td>Project manager</td>
<td>16</td>
<td>5</td>
<td>21</td>
<td>32.65%</td>
<td>15.63%</td>
<td>25.93%</td>
</tr>
<tr>
<td>PR officer</td>
<td>4</td>
<td>2</td>
<td>6</td>
<td>8.16%</td>
<td>6.25%</td>
<td>7.41%</td>
</tr>
<tr>
<td>Other</td>
<td>12</td>
<td>10</td>
<td>22</td>
<td>24.49%</td>
<td>31.25%</td>
<td>27.16%</td>
</tr>
<tr>
<td>Total</td>
<td>49</td>
<td>35</td>
<td>81</td>
<td>100%</td>
<td>100%</td>
<td>100%</td>
</tr>
</tbody>
</table>

Table 5. Number and percentage of the position the person who was surveyed has in the company.

5.3 PART 2 WEB SURVEY: GENERAL

Question 3. Please, state the activities of your company and approximate share of individual activities.

Comment: Please tick the activity your company carries out (on square located extreme left) and provide the percentage for each activity in %, with respect to your total scope of activities.

<table>
<thead>
<tr>
<th>Activities</th>
<th>Slovenian companies</th>
<th>European companies</th>
<th>Global analysis</th>
<th>%Slovenian</th>
<th>%European</th>
<th>%Global</th>
</tr>
</thead>
<tbody>
<tr>
<td>Construction</td>
<td>32</td>
<td>26</td>
<td>58</td>
<td>62.62%</td>
<td>72.30%</td>
<td>66.65%</td>
</tr>
<tr>
<td>Production (constr.mat./products)</td>
<td>15</td>
<td>13</td>
<td>28</td>
<td>18.10%</td>
<td>12.17%</td>
<td>15.63%</td>
</tr>
<tr>
<td>Engineering (construction management)</td>
<td>14</td>
<td>10</td>
<td>24</td>
<td>11.55%</td>
<td>11.17%</td>
<td>11.39%</td>
</tr>
<tr>
<td>Other</td>
<td>7</td>
<td>7</td>
<td>14</td>
<td>7.74%</td>
<td>4.37%</td>
<td>6.33%</td>
</tr>
<tr>
<td>Total</td>
<td></td>
<td></td>
<td></td>
<td>100%</td>
<td>100%</td>
<td>100%</td>
</tr>
</tbody>
</table>

Table 6. Percentage of companies’ activities.
Question 4. Please state the number of employees of your company.

<table>
<thead>
<tr>
<th>Number employees</th>
<th>Slovenian companies</th>
<th>European companies</th>
<th>Global analysis</th>
<th>%Slovenian</th>
<th>%European</th>
<th>%Global</th>
</tr>
</thead>
<tbody>
<tr>
<td>0-50</td>
<td>13</td>
<td>5</td>
<td>18</td>
<td>26.53%</td>
<td>15.63%</td>
<td>22.22%</td>
</tr>
<tr>
<td>50-250</td>
<td>18</td>
<td>9</td>
<td>27</td>
<td>36.73%</td>
<td>28.13%</td>
<td>33.33%</td>
</tr>
<tr>
<td>250-500</td>
<td>14</td>
<td>8</td>
<td>22</td>
<td>28.57%</td>
<td>25.00%</td>
<td>27.16%</td>
</tr>
<tr>
<td>500-1000</td>
<td>4</td>
<td>5</td>
<td>9</td>
<td>8.16%</td>
<td>15.63%</td>
<td>11.11%</td>
</tr>
<tr>
<td>More than 1000</td>
<td>0</td>
<td>5</td>
<td>5</td>
<td>0%</td>
<td>15.63%</td>
<td>6.17%</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td><strong>49</strong></td>
<td><strong>32</strong></td>
<td><strong>81</strong></td>
<td><strong>100%</strong></td>
<td><strong>100%</strong></td>
<td><strong>100%</strong></td>
</tr>
</tbody>
</table>

Table 7. Number and percentage of the number of employees.

Question 5. Please, provide the approximate number of permanent and temporary production/storage locations in your company.

<table>
<thead>
<tr>
<th>Locations</th>
<th>Slovenian companies</th>
<th>European companies</th>
<th>Global analysis</th>
<th>%Slovenian</th>
<th>%European</th>
<th>%Global</th>
</tr>
</thead>
<tbody>
<tr>
<td>Permanent locations: 1-5</td>
<td>39</td>
<td>18</td>
<td>57</td>
<td>79.59%</td>
<td>56.25%</td>
<td>70.37%</td>
</tr>
<tr>
<td>Permanent locations: 5-10</td>
<td>7</td>
<td>4</td>
<td>11</td>
<td>14.29%</td>
<td>12.50%</td>
<td>13.58%</td>
</tr>
<tr>
<td>Permanent locations: &gt;10</td>
<td>3</td>
<td>10</td>
<td>13</td>
<td>6.12%</td>
<td>31.25%</td>
<td>16.05%</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td><strong>49</strong></td>
<td><strong>32</strong></td>
<td><strong>81</strong></td>
<td><strong>100%</strong></td>
<td><strong>100%</strong></td>
<td><strong>100%</strong></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Locations</th>
<th>Slovenian companies</th>
<th>European companies</th>
<th>Global analysis</th>
<th>%Slovenian</th>
<th>%European</th>
<th>%Global</th>
</tr>
</thead>
<tbody>
<tr>
<td>Temporary locations: 1-5</td>
<td>15</td>
<td>9</td>
<td>24</td>
<td>55.56%</td>
<td>36.00%</td>
<td>46.15%</td>
</tr>
<tr>
<td>Temporary locations: 5-10</td>
<td>8</td>
<td>3</td>
<td>11</td>
<td>29.63%</td>
<td>12.00%</td>
<td>21.15%</td>
</tr>
<tr>
<td>Temporary locations: &gt;10</td>
<td>4</td>
<td>13</td>
<td>17</td>
<td>14.81%</td>
<td>52.00%</td>
<td>32.69%</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td><strong>27</strong></td>
<td><strong>25</strong></td>
<td><strong>52</strong></td>
<td><strong>100%</strong></td>
<td><strong>100%</strong></td>
<td><strong>100%</strong></td>
</tr>
</tbody>
</table>

Table 8. Number and percentage of permanent and temporary locations.
5.4 PART 3 WEB SURVEY: QUALITY

Question 6. Has your company established (any kind of) quality policy? Have you determined/specified the goals and procedures?

Table 9. Number and percentage of companies with established quality policy.

<table>
<thead>
<tr>
<th>Possibilities</th>
<th>Slovenian companies</th>
<th>European companies</th>
<th>Global analysis</th>
<th>%Slovenian</th>
<th>%European</th>
<th>%Global</th>
</tr>
</thead>
<tbody>
<tr>
<td>Yes</td>
<td>42</td>
<td>30</td>
<td>72</td>
<td>85.71%</td>
<td>93.75%</td>
<td>88.89%</td>
</tr>
<tr>
<td>No</td>
<td>7</td>
<td>2</td>
<td>9</td>
<td>14.29%</td>
<td>6.25%</td>
<td>11.11%</td>
</tr>
<tr>
<td>Total</td>
<td>49</td>
<td>32</td>
<td>81</td>
<td>100%</td>
<td>100%</td>
<td>100%</td>
</tr>
</tbody>
</table>

Question 7. Has your company implemented any type of quality management system or program that would enable to conform to the quality management?

Table 10. Number and percentage of the type of implemented quality management system.

<table>
<thead>
<tr>
<th>Possibilities</th>
<th>Slovenian companies</th>
<th>European companies</th>
<th>Global analysis</th>
<th>%Slovenian</th>
<th>%European</th>
<th>%Global</th>
</tr>
</thead>
<tbody>
<tr>
<td>Yes, ISO 9001</td>
<td>41</td>
<td>28</td>
<td>69</td>
<td>83.67%</td>
<td>87.50%</td>
<td>85.19%</td>
</tr>
<tr>
<td>Yes</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>2.04%</td>
<td>6.25%</td>
<td>3.70%</td>
</tr>
<tr>
<td>No</td>
<td>7</td>
<td>2</td>
<td>9</td>
<td>14.29%</td>
<td>6.25%</td>
<td>11.11%</td>
</tr>
<tr>
<td>Total</td>
<td>49</td>
<td>32</td>
<td>81</td>
<td>100%</td>
<td>100%</td>
<td>100%</td>
</tr>
</tbody>
</table>
Question 8. If you have established a certified QMS (ISO 9001-compliant), who was the certification body?

<table>
<thead>
<tr>
<th>Country/ies</th>
<th>Number of responses</th>
</tr>
</thead>
<tbody>
<tr>
<td>Slovenia</td>
<td>29</td>
</tr>
<tr>
<td>Europe</td>
<td>14</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td><strong>43</strong></td>
</tr>
</tbody>
</table>

Table 11. Number of responses obtained for each country/ies.

Question 9. Please, provide an estimate for the percentage (share) of your previously existing QMS that could be kept during the implementation of the ISO 9001-compliant standard.

<table>
<thead>
<tr>
<th>Percentage</th>
<th>Slovenian companies</th>
<th>European companies</th>
<th>Global analysis</th>
<th>%Slovenian</th>
<th>%European</th>
<th>%Global</th>
</tr>
</thead>
<tbody>
<tr>
<td>100%</td>
<td>14</td>
<td>12</td>
<td>26</td>
<td>34.15%</td>
<td>42.86%</td>
<td>37.68%</td>
</tr>
<tr>
<td>75-100%</td>
<td>4</td>
<td>4</td>
<td>8</td>
<td>9.76%</td>
<td>14.29%</td>
<td><strong>11.59%</strong></td>
</tr>
<tr>
<td>50-75%</td>
<td>10</td>
<td>8</td>
<td>18</td>
<td>24.39%</td>
<td>28.57%</td>
<td><strong>26.09%</strong></td>
</tr>
<tr>
<td>25-50%</td>
<td>6</td>
<td>0</td>
<td>6</td>
<td>14.63%</td>
<td>0.00%</td>
<td><strong>8.70%</strong></td>
</tr>
<tr>
<td>1-25%</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0.00%</td>
<td>0.00%</td>
<td>0.00%</td>
</tr>
<tr>
<td>0%</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0.00%</td>
<td>0.00%</td>
<td>0.00%</td>
</tr>
<tr>
<td><strong>There was no QMS before</strong></td>
<td>7</td>
<td>4</td>
<td>11</td>
<td>17.07%</td>
<td>14.29%</td>
<td><strong>15.94%</strong></td>
</tr>
</tbody>
</table>

Table 12. Number and percentage of previously existing QMS that could be kept during the implementation of the ISO 9001.
Question 10. Has your scope of acquired works increased since you have implemented the ISO 9001 standard?

<table>
<thead>
<tr>
<th>Possibilities</th>
<th>Slovenian companies</th>
<th>European companies</th>
<th>Global analysis</th>
<th>%Slovenian</th>
<th>%European</th>
<th>%Global</th>
</tr>
</thead>
<tbody>
<tr>
<td>Yes</td>
<td>27</td>
<td>20</td>
<td><strong>47</strong></td>
<td>65.85%</td>
<td>71.43%</td>
<td><strong>68.12%</strong></td>
</tr>
<tr>
<td>No</td>
<td>14</td>
<td>8</td>
<td><strong>22</strong></td>
<td>34.15%</td>
<td>28.57%</td>
<td><strong>31.88%</strong></td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td><strong>41</strong></td>
<td><strong>28</strong></td>
<td><strong>69</strong></td>
<td><strong>100%</strong></td>
<td><strong>100%</strong></td>
<td><strong>100%</strong></td>
</tr>
</tbody>
</table>

Table 13. Number and percentage of acquired works increased since you have implemented the ISO 9001.

Question 11. Why have you decided to establish an ISO 9001 compliant QMS?
Please add important reasons for you, if they are not listed.

Comment: please rank the below listed reasons according to perceived importance; 1=most important, 5= least important.

<table>
<thead>
<tr>
<th>Reasons</th>
<th>1</th>
<th>2</th>
<th>3</th>
<th>4</th>
<th>5</th>
<th>N/A</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Slovenian companies</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>To conform to the clients' demands</td>
<td>12</td>
<td>8</td>
<td>9</td>
<td>6</td>
<td>5</td>
<td>1</td>
<td><strong>41</strong> 100%</td>
</tr>
<tr>
<td>To improve the transparency of the company management</td>
<td>10</td>
<td>14</td>
<td>6</td>
<td>5</td>
<td>5</td>
<td></td>
<td><strong>40</strong> 100%</td>
</tr>
<tr>
<td>Cost reduction</td>
<td>13</td>
<td>13</td>
<td>9</td>
<td>5</td>
<td></td>
<td></td>
<td><strong>40</strong> 100%</td>
</tr>
<tr>
<td>Other</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>9</td>
<td><strong>19</strong> 100%</td>
</tr>
<tr>
<td><strong>European companies</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>To conform to the clients' demands</td>
<td>10</td>
<td>5</td>
<td>9</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td><strong>26</strong> 100%</td>
</tr>
<tr>
<td>To improve the transparency of the company management</td>
<td>16</td>
<td>4</td>
<td>2</td>
<td></td>
<td>6</td>
<td></td>
<td><strong>28</strong> 100%</td>
</tr>
<tr>
<td>Cost reduction</td>
<td>3</td>
<td>14</td>
<td>2</td>
<td>4</td>
<td>1</td>
<td></td>
<td><strong>24</strong> 100%</td>
</tr>
<tr>
<td>Other</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>4</td>
<td><strong>8</strong></td>
</tr>
</tbody>
</table>
Question 12. Will your company try to establish an ISO 9001-compliant quality management system in the near future?

<table>
<thead>
<tr>
<th>Possibilities</th>
<th>Slovenian companies</th>
<th>European companies</th>
<th>Global analysis</th>
<th>%Slovenian</th>
<th>%European</th>
<th>%Global</th>
</tr>
</thead>
<tbody>
<tr>
<td>Yes</td>
<td>3</td>
<td>2</td>
<td>5</td>
<td>37.50%</td>
<td>50.00%</td>
<td>41.67%</td>
</tr>
<tr>
<td>No</td>
<td>3</td>
<td>1</td>
<td>4</td>
<td>37.50%</td>
<td>25.00%</td>
<td>33.33%</td>
</tr>
<tr>
<td>No comment</td>
<td>2</td>
<td>1</td>
<td>3</td>
<td>25.00%</td>
<td>25.00%</td>
<td>25.00%</td>
</tr>
<tr>
<td>Total</td>
<td>8</td>
<td>4</td>
<td>12</td>
<td>100%</td>
<td>100%</td>
<td>100%</td>
</tr>
</tbody>
</table>

Table 15. Number and percentage of companies that will try to establish an ISO 9001.
Question 13. If you do not hold an ISO 9001-compliant QMS, please provide and rank the reasons why you have not decided to implement the ISO 9001 standard.
Comment: please rank the reasons according to perceived importance, 1=most important, 5=least important.

<table>
<thead>
<tr>
<th>Reasons</th>
<th>1</th>
<th>2</th>
<th>3</th>
<th>4</th>
<th>5</th>
<th>N/A</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Slovenian companies</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>We are in the process of ISO 9001 implementation</td>
<td>2</td>
<td>2</td>
<td>1</td>
<td>1</td>
<td></td>
<td>6</td>
<td>100%</td>
</tr>
<tr>
<td></td>
<td>33.33%</td>
<td>33.33%</td>
<td>16.67%</td>
<td>16.67%</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>There is no need to implement this standard in our sector</td>
<td></td>
<td>1</td>
<td>2</td>
<td>2</td>
<td>2</td>
<td>7</td>
<td>100%</td>
</tr>
<tr>
<td></td>
<td></td>
<td>14.29%</td>
<td>28.57%</td>
<td>28.57%</td>
<td>28.57%</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Having an ISO 9001 compliant QMS is not a significant competitive advantage</td>
<td>2</td>
<td>2</td>
<td>1</td>
<td>3</td>
<td></td>
<td>8</td>
<td>100%</td>
</tr>
<tr>
<td></td>
<td>25.00%</td>
<td>25.00%</td>
<td>12.50%</td>
<td>37.50%</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Costs of the certification are too high</td>
<td></td>
<td>4</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>7</td>
<td>100%</td>
</tr>
<tr>
<td></td>
<td>57.14%</td>
<td>14.29%</td>
<td>14.29%</td>
<td>14.29%</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Other</td>
<td></td>
<td>1</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>3</td>
</tr>
<tr>
<td></td>
<td>33.33%</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>European companies</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>We are in the process of ISO 9001 implementation</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td></td>
<td>1</td>
<td>3</td>
<td>100%</td>
</tr>
<tr>
<td></td>
<td>33.33%</td>
<td>33.33%</td>
<td>33.33%</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>There is no need to implement this standard in our sector</td>
<td></td>
<td>2</td>
<td>1</td>
<td></td>
<td></td>
<td>4</td>
<td>100%</td>
</tr>
<tr>
<td></td>
<td>25.00%</td>
<td>50.00%</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Having an ISO 9001 compliant QMS is not a significant competitive advantage</td>
<td>1</td>
<td>2</td>
<td>1</td>
<td>2</td>
<td></td>
<td>4</td>
<td>100%</td>
</tr>
<tr>
<td></td>
<td>25.00%</td>
<td>25.00%</td>
<td>25.00%</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Costs of the certification are too high</td>
<td></td>
<td>2</td>
<td></td>
<td></td>
<td></td>
<td>4</td>
<td>100%</td>
</tr>
<tr>
<td></td>
<td>50.00%</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Other</td>
<td></td>
<td></td>
<td>1</td>
<td></td>
<td></td>
<td>1</td>
<td>100%</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>100%</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Global analysis</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>9</td>
<td>100%</td>
</tr>
<tr>
<td>We are in the process of ISO 9001 implementation</td>
<td>2</td>
<td>1</td>
<td>3</td>
<td>1</td>
<td>2</td>
<td>9</td>
<td>100%</td>
</tr>
<tr>
<td></td>
<td>22.22%</td>
<td>11.11%</td>
<td>33.33%</td>
<td>11.11%</td>
<td>22.22%</td>
<td></td>
<td></td>
</tr>
<tr>
<td>There is no need to implement this standard in our sector</td>
<td>2</td>
<td>2</td>
<td>2</td>
<td>4</td>
<td>1</td>
<td>11</td>
<td>100%</td>
</tr>
<tr>
<td></td>
<td>18.18%</td>
<td>18.18%</td>
<td>18.18%</td>
<td>36.36%</td>
<td>9.09%</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Having an ISO 9001 compliant QMS is not a significant competitive advantage</td>
<td>3</td>
<td>1</td>
<td>2</td>
<td>2</td>
<td></td>
<td>12</td>
<td>100%</td>
</tr>
<tr>
<td></td>
<td>25.00%</td>
<td>8.33%</td>
<td>16.67%</td>
<td>16.67%</td>
<td>33.33%</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
Question 14. Do the clients (investors) require an established QMS in order to get the contract?

<table>
<thead>
<tr>
<th>Possibilities</th>
<th>Slovenian companies</th>
<th>European companies</th>
<th>Global analysis</th>
<th>%Slovenian</th>
<th>%European</th>
<th>%Global</th>
</tr>
</thead>
<tbody>
<tr>
<td>Yes</td>
<td>19</td>
<td>17</td>
<td>36</td>
<td>38.78%</td>
<td>53.13%</td>
<td>44.44%</td>
</tr>
<tr>
<td>No</td>
<td>8</td>
<td>5</td>
<td>13</td>
<td>16.33%</td>
<td>15.63%</td>
<td>16.05%</td>
</tr>
<tr>
<td>Not often</td>
<td>22</td>
<td>10</td>
<td>32</td>
<td>44.90%</td>
<td>31.25%</td>
<td>39.51%</td>
</tr>
<tr>
<td>Total</td>
<td>49</td>
<td>32</td>
<td>81</td>
<td>100%</td>
<td>100%</td>
<td>100%</td>
</tr>
</tbody>
</table>

Table 17. Number and percentage of clients who require QMS to get the contract.

5.5 PART 4 WEB SURVEY: ENVIRONMENT

Question 15. Does your company hold an environmental management policy? Have you determined the environmental goals and procedures?

<table>
<thead>
<tr>
<th>Possibilities</th>
<th>Slovenian companies</th>
<th>European companies</th>
<th>Global analysis</th>
<th>%Slovenian</th>
<th>%European</th>
<th>%Global</th>
</tr>
</thead>
<tbody>
<tr>
<td>Yes</td>
<td>31</td>
<td>25</td>
<td>56</td>
<td>63.27%</td>
<td>78.13%</td>
<td>69.14%</td>
</tr>
<tr>
<td>No</td>
<td>18</td>
<td>7</td>
<td>25</td>
<td>36.73%</td>
<td>21.88%</td>
<td>30.86%</td>
</tr>
<tr>
<td>Total</td>
<td>49</td>
<td>32</td>
<td>81</td>
<td>100%</td>
<td>100%</td>
<td>100%</td>
</tr>
</tbody>
</table>

Table 18. Number and percentage of companies that hold an environment management system.
Question 16. Please provide the areas (of environmental management) where your company places the focus. If there are areas you focus on, but they are not listed, please add them to the list.

Comment: Please indicate the rank of importance (as you perceive) of listed areas in the squares on extreme right. If you focus to areas that are not listed in the table, please provide (and rank) them as well. (1=most important, 7=least important).

<table>
<thead>
<tr>
<th>Areas</th>
<th>1</th>
<th>2</th>
<th>3</th>
<th>4</th>
<th>5</th>
<th>6</th>
<th>7</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Slovenian companies</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Energy savings</td>
<td>11</td>
<td>15</td>
<td>5</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>31</td>
</tr>
<tr>
<td></td>
<td>35.48%</td>
<td>48.39%</td>
<td>16.13%</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Recycling of materials</td>
<td>4</td>
<td>15</td>
<td>7</td>
<td>5</td>
<td></td>
<td></td>
<td></td>
<td>31</td>
</tr>
<tr>
<td></td>
<td>12.90%</td>
<td>48.39%</td>
<td>22.58%</td>
<td>16.13%</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Waste control</td>
<td>18</td>
<td>7</td>
<td>6</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>31</td>
</tr>
<tr>
<td></td>
<td>58.06%</td>
<td>22.58%</td>
<td>19.35%</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Noise prevention</td>
<td>7</td>
<td>5</td>
<td>7</td>
<td>5</td>
<td>5</td>
<td>2</td>
<td></td>
<td>31</td>
</tr>
<tr>
<td></td>
<td>22.58%</td>
<td>16.13%</td>
<td>22.58%</td>
<td>16.13%</td>
<td>16.13%</td>
<td>6.45%</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Air pollution control</td>
<td>5</td>
<td>11</td>
<td>5</td>
<td>5</td>
<td>3</td>
<td>1</td>
<td>1</td>
<td>31</td>
</tr>
<tr>
<td></td>
<td>16.13%</td>
<td>35.48%</td>
<td>16.13%</td>
<td>16.13%</td>
<td>9.68%</td>
<td>3.23%</td>
<td>3.23%</td>
<td></td>
</tr>
<tr>
<td>Other</td>
<td>4</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>4</td>
</tr>
<tr>
<td></td>
<td>100.00%</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>European companies</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Energy savings</td>
<td>10</td>
<td>3</td>
<td>6</td>
<td>5</td>
<td>1</td>
<td></td>
<td></td>
<td>25</td>
</tr>
<tr>
<td></td>
<td>40.00%</td>
<td>12.00%</td>
<td>24.00%</td>
<td>20.00%</td>
<td>4.00%</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Recycling of materials</td>
<td>13</td>
<td>3</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>5</td>
<td>1</td>
<td>25</td>
</tr>
<tr>
<td></td>
<td>52.00%</td>
<td>12.00%</td>
<td>4.00%</td>
<td>4.00%</td>
<td>4.00%</td>
<td>25.00%</td>
<td>4.00%</td>
<td></td>
</tr>
<tr>
<td>Waste control</td>
<td>14</td>
<td>3</td>
<td>4</td>
<td>1</td>
<td>3</td>
<td></td>
<td></td>
<td>25</td>
</tr>
<tr>
<td></td>
<td>56.00%</td>
<td>12.00%</td>
<td>16.00%</td>
<td>4.00%</td>
<td>12.00%</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Noise prevention</td>
<td>6</td>
<td>18</td>
<td></td>
<td>1</td>
<td></td>
<td></td>
<td></td>
<td>25</td>
</tr>
<tr>
<td></td>
<td>24.00%</td>
<td>72.00%</td>
<td>4.00%</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Air pollution control</td>
<td>7</td>
<td>6</td>
<td>12</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>25</td>
</tr>
<tr>
<td></td>
<td>28.00%</td>
<td>24.00%</td>
<td>48.00%</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Other</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Global analysis</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

62
Study on Environmental Management Systems in construction companies

<table>
<thead>
<tr>
<th>Energy savings</th>
<th>Recycling of materials</th>
<th>Waste control</th>
<th>Noise prevention</th>
<th>Air pollution control</th>
<th>Other</th>
</tr>
</thead>
<tbody>
<tr>
<td>21</td>
<td>17</td>
<td>32</td>
<td>13</td>
<td>12</td>
<td>4</td>
</tr>
<tr>
<td>37.50%</td>
<td>30.36%</td>
<td>57.14%</td>
<td>23.21%</td>
<td>21.43%</td>
<td>100%</td>
</tr>
<tr>
<td>18</td>
<td>18</td>
<td>10</td>
<td>23</td>
<td>17</td>
<td></td>
</tr>
<tr>
<td>32.14%</td>
<td>32.14%</td>
<td>17.86%</td>
<td>41.07%</td>
<td>30.36%</td>
<td></td>
</tr>
<tr>
<td>11</td>
<td>8</td>
<td>10</td>
<td>1</td>
<td>17</td>
<td></td>
</tr>
<tr>
<td>19.64%</td>
<td>10.71%</td>
<td>17.86%</td>
<td>1.79%</td>
<td>8.93%</td>
<td></td>
</tr>
<tr>
<td>5</td>
<td>6</td>
<td>1</td>
<td>7</td>
<td>5</td>
<td></td>
</tr>
<tr>
<td>8.93%</td>
<td>1.79%</td>
<td>1.79%</td>
<td>12.50%</td>
<td>8.93%</td>
<td></td>
</tr>
<tr>
<td>1</td>
<td>1</td>
<td>3</td>
<td>5</td>
<td>3</td>
<td></td>
</tr>
<tr>
<td>1.79%</td>
<td>1.79%</td>
<td>5.36%</td>
<td>8.93%</td>
<td>1.79%</td>
<td></td>
</tr>
<tr>
<td>56</td>
<td>31</td>
<td>13</td>
<td>12</td>
<td>12</td>
<td>31</td>
</tr>
<tr>
<td>100%</td>
<td>100%</td>
<td>56</td>
<td>100%</td>
<td>100%</td>
<td></td>
</tr>
</tbody>
</table>

Table 19. Number and percentage of areas where companies place the focus.

**Question 17.** Is there a protocol how the project documentation in the execution phase should be prepared/extended? (In order to account for the environmental issues).

<table>
<thead>
<tr>
<th>Possibilities</th>
<th>Slovenian companies</th>
<th>European companies</th>
<th>Global analysis</th>
<th>%Slovenian</th>
<th>%European</th>
<th>%Global</th>
</tr>
</thead>
<tbody>
<tr>
<td>Yes</td>
<td>22</td>
<td>20</td>
<td>42</td>
<td>70.97%</td>
<td>80.00%</td>
<td>75.00%</td>
</tr>
<tr>
<td>No</td>
<td>9</td>
<td>5</td>
<td>14</td>
<td>29.03%</td>
<td>20.00%</td>
<td>25.00%</td>
</tr>
<tr>
<td>Total</td>
<td>31</td>
<td>25</td>
<td>56</td>
<td>100%</td>
<td>100%</td>
<td>100%</td>
</tr>
</tbody>
</table>

Table 20. Number and percentage of companies with a protocol.

**Question 18.** Has your company established any kind of environmental management system, or other program that could ensure the conformance to the environmental policy?

<table>
<thead>
<tr>
<th>Possibilities</th>
<th>Slovenian companies</th>
<th>European companies</th>
<th>Global analysis</th>
<th>%Slovenian</th>
<th>%European</th>
<th>%Global</th>
</tr>
</thead>
<tbody>
<tr>
<td>Yes, ISO 14001</td>
<td>8</td>
<td>7</td>
<td>15</td>
<td>25.81%</td>
<td>28.00%</td>
<td>26.79%</td>
</tr>
<tr>
<td>Yes</td>
<td>20</td>
<td>17</td>
<td>37</td>
<td>64.52%</td>
<td>68.00%</td>
<td>66.07%</td>
</tr>
</tbody>
</table>
### Table 21. Number and percentage of companies with EMS.

**Question 19. Have you assigned the responsibility for the EMS to a member of the top management?**

<table>
<thead>
<tr>
<th>Possibilities</th>
<th>Slovenian companies</th>
<th>European companies</th>
<th>Global analysis</th>
<th>%Slovenian</th>
<th>%European</th>
<th>%Global</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Yes</strong></td>
<td>18</td>
<td>18</td>
<td>36</td>
<td>64.29%</td>
<td>75.00%</td>
<td>69.23%</td>
</tr>
<tr>
<td><strong>No</strong></td>
<td>10</td>
<td>6</td>
<td>16</td>
<td>35.71%</td>
<td>25.00%</td>
<td>30.77%</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td>28</td>
<td>24</td>
<td>52</td>
<td>100%</td>
<td>100%</td>
<td>100%</td>
</tr>
</tbody>
</table>

Table 22. Number and percentage of companies with a member of the top management being responsible for the EMS.

### Table 22. Number and percentage of companies with QMS and EMS integrated.

**Question 20. Are the existing QMS and EMS integrated?**

<table>
<thead>
<tr>
<th>Possibilities</th>
<th>Slovenian companies</th>
<th>European companies</th>
<th>Global analysis</th>
<th>%Slovenian</th>
<th>%European</th>
<th>%Global</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Yes</strong></td>
<td>22</td>
<td>20</td>
<td>42</td>
<td>78.57%</td>
<td>83.33%</td>
<td>80.77%</td>
</tr>
<tr>
<td><strong>No</strong></td>
<td>6</td>
<td>4</td>
<td>10</td>
<td>21.43%</td>
<td>16.37%</td>
<td>19.23%</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td>28</td>
<td>24</td>
<td>52</td>
<td>100%</td>
<td>100%</td>
<td>100%</td>
</tr>
</tbody>
</table>

Table 23. Number and percentage of companies with QMS and EMS integrated.

### Question 21. How much of the previously existing EMS could you keep at the establishment of the ISO 14001-compliant EMS?

<table>
<thead>
<tr>
<th>Percentage</th>
<th>Slovenian companies</th>
<th>European companies</th>
<th>Global analysis</th>
<th>%Slovenian</th>
<th>%European</th>
<th>%Global</th>
</tr>
</thead>
<tbody>
<tr>
<td>100%</td>
<td>8</td>
<td>2</td>
<td>10</td>
<td>40.00%</td>
<td>11.76%</td>
<td>27.03%</td>
</tr>
<tr>
<td>75-100%</td>
<td>6</td>
<td>6</td>
<td>12</td>
<td>30.00%</td>
<td>35.29%</td>
<td>32.43%</td>
</tr>
</tbody>
</table>
Study on Environmental Management Systems in construction companies

<table>
<thead>
<tr>
<th>Possibilities</th>
<th>Slovenian companies</th>
<th>European companies</th>
<th>Global analysis</th>
<th>%Slovenian</th>
<th>%European</th>
<th>%Global</th>
</tr>
</thead>
<tbody>
<tr>
<td>Yes</td>
<td>30</td>
<td>24</td>
<td>54</td>
<td>61.22%</td>
<td>75.00%</td>
<td>66.67%</td>
</tr>
<tr>
<td>No</td>
<td>19</td>
<td>8</td>
<td>27</td>
<td>38.78%</td>
<td>25.00%</td>
<td>33.33%</td>
</tr>
<tr>
<td>Total</td>
<td>49</td>
<td>32</td>
<td>81</td>
<td>100%</td>
<td>100%</td>
<td>100%</td>
</tr>
</tbody>
</table>

Table 25. Number and percentage of companies with a list of potential problems.

Question 23. Are you following the changes of the environment-related legislature?

Do you have a defined and documented procedure for this issue?

<table>
<thead>
<tr>
<th>Possibilities</th>
<th>Slovenian companies</th>
<th>European companies</th>
<th>Global analysis</th>
<th>%Slovenian</th>
<th>%European</th>
<th>%Global</th>
</tr>
</thead>
<tbody>
<tr>
<td>Yes</td>
<td>28</td>
<td>24</td>
<td>52</td>
<td>57.14%</td>
<td>75.00%</td>
<td>64.20%</td>
</tr>
<tr>
<td>No</td>
<td>21</td>
<td>8</td>
<td>29</td>
<td>42.86%</td>
<td>25.00%</td>
<td>35.80%</td>
</tr>
<tr>
<td>Total</td>
<td>49</td>
<td>32</td>
<td>81</td>
<td>100%</td>
<td>100%</td>
<td>100%</td>
</tr>
</tbody>
</table>

Table 26. Number and percentage of companies that follow the changes of the environment legislature.
Question 24. If your organization has not yet established an EMS, or if it is not ISO 14001-compliant, please list the elements of environmental management that already exist:

![Table showing number of responses by country](image)

<table>
<thead>
<tr>
<th>Country/ies</th>
<th>Number of responses</th>
</tr>
</thead>
<tbody>
<tr>
<td>Slovenia</td>
<td>5</td>
</tr>
<tr>
<td>Europe</td>
<td>2</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td><strong>7</strong></td>
</tr>
</tbody>
</table>

Table 27. Number of responses for each country/ies.

Question 25. Will your company try to establish an ISO 14001-compliant EMS in the near future?

![Table showing number of companies trying to establish ISO 14001](image)

<table>
<thead>
<tr>
<th>Possibilities</th>
<th>Slovenian companies</th>
<th>European companies</th>
<th>Global analysis</th>
<th>%Slovenian</th>
<th>%European</th>
<th>%Global</th>
</tr>
</thead>
<tbody>
<tr>
<td>Yes</td>
<td>19</td>
<td>11</td>
<td>30</td>
<td>65.52%</td>
<td>73.33%</td>
<td>68.18%</td>
</tr>
<tr>
<td>No</td>
<td>5</td>
<td>2</td>
<td>7</td>
<td>17.24%</td>
<td>13.33%</td>
<td>15.91%</td>
</tr>
<tr>
<td>No comment</td>
<td>5</td>
<td>2</td>
<td>7</td>
<td>17.24%</td>
<td>13.33%</td>
<td>15.91%</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td><strong>29</strong></td>
<td><strong>15</strong></td>
<td><strong>44</strong></td>
<td><strong>100%</strong></td>
<td><strong>100%</strong></td>
<td><strong>100%</strong></td>
</tr>
</tbody>
</table>

Table 28. Number and percentage of companies which try to establish ISO 14001 in the near future.
Question 26. Do you see (perceive) any barriers in the ISO 14001-compliant EMS implementation? Please rank the barriers listed below according to the perceived importance.

Comment: 1=most important, 5= least important.

<table>
<thead>
<tr>
<th>Barriers</th>
<th>1</th>
<th>2</th>
<th>3</th>
<th>4</th>
<th>5</th>
<th>N/A</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Slovenian companies</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Lack of pressure for the governmental/ legislative side</td>
<td>9</td>
<td>15</td>
<td>6</td>
<td>5</td>
<td>13</td>
<td></td>
<td>48</td>
</tr>
<tr>
<td>Lack of support / demands from the customer side</td>
<td>7</td>
<td>15</td>
<td>12</td>
<td>3</td>
<td>12</td>
<td></td>
<td>49</td>
</tr>
<tr>
<td>Large costs of the EMS establishment</td>
<td>23</td>
<td>10</td>
<td>11</td>
<td>2</td>
<td>2</td>
<td></td>
<td>49</td>
</tr>
<tr>
<td>Sub-contracting creates problems in the EMS implementation</td>
<td>9</td>
<td>12</td>
<td>11</td>
<td>6</td>
<td>11</td>
<td></td>
<td>49</td>
</tr>
<tr>
<td>Lack of environmentally friendly technologies and materials</td>
<td>7</td>
<td>13</td>
<td>5</td>
<td>9</td>
<td>11</td>
<td></td>
<td>48</td>
</tr>
<tr>
<td>Inadequacy of standards (different interpretation in construction industry)</td>
<td>3</td>
<td>9</td>
<td>14</td>
<td>7</td>
<td>12</td>
<td></td>
<td>48</td>
</tr>
<tr>
<td>Complicated documentation process</td>
<td>16</td>
<td>6</td>
<td>9</td>
<td>5</td>
<td>2</td>
<td></td>
<td>11</td>
</tr>
<tr>
<td>Lack of support from workers' side</td>
<td>7</td>
<td>6</td>
<td>9</td>
<td>6</td>
<td>15</td>
<td></td>
<td>15</td>
</tr>
<tr>
<td>Poor environmental culture among competition</td>
<td>12</td>
<td>9</td>
<td>4</td>
<td>1</td>
<td>12</td>
<td></td>
<td>12</td>
</tr>
<tr>
<td>Separate design and execution in construction process</td>
<td>7</td>
<td>13</td>
<td>8</td>
<td>5</td>
<td>15</td>
<td></td>
<td>15</td>
</tr>
<tr>
<td>Nobody (no other construction company) starts first</td>
<td>3</td>
<td>15</td>
<td>11</td>
<td>3</td>
<td>15</td>
<td></td>
<td>15</td>
</tr>
<tr>
<td><strong>European companies</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Lack of pressure for the governmental/ legislative side</td>
<td>4</td>
<td>2</td>
<td>5</td>
<td>5</td>
<td>8</td>
<td>6</td>
<td>30</td>
</tr>
<tr>
<td>Lack of support / demands from the customer side</td>
<td>6</td>
<td>5</td>
<td>7</td>
<td>8</td>
<td>2</td>
<td></td>
<td>32</td>
</tr>
<tr>
<td>Large costs of the EMS establishment</td>
<td>15</td>
<td>11</td>
<td></td>
<td></td>
<td></td>
<td>6</td>
<td>32</td>
</tr>
</tbody>
</table>
### Study on Environmental Management Systems in construction companies

#### Global analysis

<table>
<thead>
<tr>
<th></th>
<th>4</th>
<th>5</th>
<th>7</th>
<th>5</th>
<th>6</th>
<th>32</th>
<th>100%</th>
</tr>
</thead>
<tbody>
<tr>
<td>Lack of pressure for the government/ legislative side</td>
<td>5.13%</td>
<td>14.10%</td>
<td>25.64%</td>
<td>14.10%</td>
<td>16.67%</td>
<td>24.36%</td>
<td>78</td>
</tr>
<tr>
<td>Lack of support / demands from the customer side</td>
<td>16.05%</td>
<td>20.00%</td>
<td>19.00%</td>
<td>11.00%</td>
<td>2.47%</td>
<td>16.00%</td>
<td>81</td>
</tr>
<tr>
<td>Large costs of the EMS establishment</td>
<td>46.91%</td>
<td>21.53%</td>
<td>13.58%</td>
<td>2.47%</td>
<td>2.47%</td>
<td>8.64%</td>
<td>81</td>
</tr>
<tr>
<td>Sub-contracting creates problems in the EMS implementation</td>
<td>22.22%</td>
<td>20.99%</td>
<td>22.22%</td>
<td>7.41%</td>
<td>6.17%</td>
<td>20.99%</td>
<td>81</td>
</tr>
<tr>
<td>Lack of environmentally friendly technologies and materials</td>
<td>15.00%</td>
<td>18.75%</td>
<td>15.00%</td>
<td>22.50%</td>
<td>10.00%</td>
<td>18.75%</td>
<td>80</td>
</tr>
<tr>
<td>Inadequacy of standards (different interpretation in construction industry)</td>
<td>8.99%</td>
<td>12.82%</td>
<td>17.95%</td>
<td>20.51%</td>
<td>16.67%</td>
<td>23.08%</td>
<td>78</td>
</tr>
<tr>
<td>Complicated documentation process</td>
<td>37.04%</td>
<td>18.52%</td>
<td>13.58%</td>
<td>7.41%</td>
<td>2.47%</td>
<td>20.99%</td>
<td>81</td>
</tr>
<tr>
<td>Lack of support from workers' side</td>
<td>13.92%</td>
<td>12.66%</td>
<td>16.46%</td>
<td>13.92%</td>
<td>26.58%</td>
<td>21.00%</td>
<td>79</td>
</tr>
<tr>
<td>Poor environmental culture among competition</td>
<td>24.05%</td>
<td>18.99%</td>
<td>22.78%</td>
<td>7.59%</td>
<td>3.80%</td>
<td>22.78%</td>
<td>79</td>
</tr>
<tr>
<td>Separate design and execution in construction process</td>
<td>14.10%</td>
<td>23.08%</td>
<td>17.95%</td>
<td>8.97%</td>
<td>8.97%</td>
<td>26.92%</td>
<td>78</td>
</tr>
</tbody>
</table>
Study on Environmental Management Systems in construction companies

<table>
<thead>
<tr>
<th>Nobody (no other construction company) starts first</th>
<th>1</th>
<th>4</th>
<th>24</th>
<th>19</th>
<th>9</th>
<th>20</th>
<th>77</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.30%</td>
<td>5.19%</td>
<td>31.17%</td>
<td>24.68%</td>
<td>11.69%</td>
<td>25.97%</td>
<td>100%</td>
<td></td>
</tr>
</tbody>
</table>

Table 29. Number and percentage of barriers in the ISO 14001.

5.6 AUXILIARY TABLES

Listed below is a sequence of important tables that have been of use for the elaboration of some graphics that were mainly used in the following section, called interpretation and analysis of the results.

5.6.1 QMS and EMS according to the size of the companies

<table>
<thead>
<tr>
<th>Types of companies</th>
<th>Slovenian companies</th>
<th>European companies</th>
<th>Global analysis</th>
<th>%Slovenian</th>
<th>%European</th>
<th>%Global</th>
</tr>
</thead>
<tbody>
<tr>
<td>Small and medium companies</td>
<td>31</td>
<td>14</td>
<td>49</td>
<td>63.27%</td>
<td>43.75%</td>
<td>55.56%</td>
</tr>
<tr>
<td>Big companies</td>
<td>18</td>
<td>18</td>
<td>32</td>
<td>36.73%</td>
<td>56.25%</td>
<td>44.44%</td>
</tr>
<tr>
<td>Total</td>
<td>49</td>
<td>32</td>
<td>81</td>
<td>100%</td>
<td>100%</td>
<td>100%</td>
</tr>
</tbody>
</table>

Table 30. Number and percentage of the types of companies according to their size.

QMS:

<table>
<thead>
<tr>
<th>Types of companies</th>
<th>Yes</th>
<th>No</th>
<th>Total</th>
<th>% YES</th>
</tr>
</thead>
<tbody>
<tr>
<td>Slovenian companies</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Small and medium companies</td>
<td>24</td>
<td>7</td>
<td>31</td>
<td>77.42%</td>
</tr>
<tr>
<td>Big companies</td>
<td>17</td>
<td>1</td>
<td>18</td>
<td>94.44%</td>
</tr>
<tr>
<td>European companies</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Small and medium companies</td>
<td>11</td>
<td>3</td>
<td>14</td>
<td>78.57%</td>
</tr>
<tr>
<td>Big companies</td>
<td>17</td>
<td>1</td>
<td>18</td>
<td>94.44%</td>
</tr>
<tr>
<td>Global</td>
<td>28</td>
<td>4</td>
<td>32</td>
<td>87.50%</td>
</tr>
</tbody>
</table>

Global analysis

| Small and medium companies | 35 | 10 | 45 | 77.78% |
Table 31. Number and percentage of the types of companies that have ISO 9001.

<table>
<thead>
<tr>
<th>Types of companies</th>
<th>Yes</th>
<th>No</th>
<th>Total</th>
<th>% YES</th>
</tr>
</thead>
<tbody>
<tr>
<td>Slovenian companies</td>
<td>15</td>
<td>16</td>
<td>31</td>
<td>48.39%</td>
</tr>
<tr>
<td>Big companies</td>
<td>16</td>
<td>2</td>
<td>18</td>
<td>88.89%</td>
</tr>
<tr>
<td>Global</td>
<td>31</td>
<td>18</td>
<td>49</td>
<td>63.27%</td>
</tr>
</tbody>
</table>

Table 32. Number and percentage of the types of companies that have environmental policy.

<table>
<thead>
<tr>
<th>Types of companies</th>
<th>Yes</th>
<th>No</th>
<th>Total</th>
<th>% YES</th>
</tr>
</thead>
<tbody>
<tr>
<td>Slovenian companies</td>
<td>12</td>
<td>3</td>
<td>15</td>
<td>80.00%</td>
</tr>
<tr>
<td>Big companies</td>
<td>16</td>
<td>0</td>
<td>16</td>
<td>100%</td>
</tr>
<tr>
<td>Global</td>
<td>28</td>
<td>3</td>
<td>31</td>
<td>90.32%</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Types of companies</th>
<th>Yes</th>
<th>No</th>
<th>Total</th>
<th>% YES</th>
</tr>
</thead>
<tbody>
<tr>
<td>European companies</td>
<td>8</td>
<td>6</td>
<td>14</td>
<td>57.14%</td>
</tr>
<tr>
<td>Big companies</td>
<td>17</td>
<td>1</td>
<td>18</td>
<td>94.44%</td>
</tr>
<tr>
<td>Global</td>
<td>25</td>
<td>7</td>
<td>32</td>
<td>78.13%</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Types of companies</th>
<th>Yes</th>
<th>No</th>
<th>Total</th>
<th>% YES</th>
</tr>
</thead>
<tbody>
<tr>
<td>Small and medium companies</td>
<td>12</td>
<td>3</td>
<td>15</td>
<td>80.00%</td>
</tr>
<tr>
<td>Big companies</td>
<td>16</td>
<td>0</td>
<td>16</td>
<td>100%</td>
</tr>
<tr>
<td>Global</td>
<td>28</td>
<td>3</td>
<td>31</td>
<td>90.32%</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Types of companies</th>
<th>Yes</th>
<th>No</th>
<th>Total</th>
<th>% YES</th>
</tr>
</thead>
<tbody>
<tr>
<td>Small and medium companies</td>
<td>7</td>
<td>1</td>
<td>8</td>
<td>87.50%</td>
</tr>
<tr>
<td>Types of companies</td>
<td>Yes</td>
<td>No</td>
<td>Total</td>
<td>% YES</td>
</tr>
<tr>
<td>--------------------</td>
<td>-----</td>
<td>----</td>
<td>-------</td>
<td>-------</td>
</tr>
<tr>
<td><strong>Slovenian companies</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Small and medium companies</td>
<td>8</td>
<td>7</td>
<td>15</td>
<td>53.33%</td>
</tr>
<tr>
<td>Big companies</td>
<td>12</td>
<td>4</td>
<td>16</td>
<td>75.00%</td>
</tr>
<tr>
<td>Global</td>
<td>20</td>
<td>11</td>
<td>31</td>
<td>64.52%</td>
</tr>
<tr>
<td><strong>European companies</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Small and medium companies</td>
<td>4</td>
<td>4</td>
<td>8</td>
<td>50.00%</td>
</tr>
<tr>
<td>Big companies</td>
<td>13</td>
<td>4</td>
<td>17</td>
<td>76.47%</td>
</tr>
<tr>
<td>Global</td>
<td>17</td>
<td>8</td>
<td>25</td>
<td>68.00%</td>
</tr>
<tr>
<td><strong>Global analysis</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Small and medium companies</td>
<td>13</td>
<td>10</td>
<td>23</td>
<td>56.52%</td>
</tr>
<tr>
<td>Big companies</td>
<td>24</td>
<td>9</td>
<td>33</td>
<td>72.73%</td>
</tr>
<tr>
<td>Global</td>
<td>37</td>
<td>19</td>
<td>56</td>
<td>66.07%</td>
</tr>
</tbody>
</table>

Table 33. Number and percentage of the types of companies that have any EMS.

Table 34. Number and percentage of the types of companies that have ISO 14001.
### 5.6.2 EMS according to the companies’ activities

<table>
<thead>
<tr>
<th>Percentage construction</th>
<th>Slovenian companies</th>
<th>European companies</th>
<th>Global analysis</th>
<th>%Slovenian</th>
<th>%European</th>
<th>%Global</th>
</tr>
</thead>
<tbody>
<tr>
<td>➢ 69%</td>
<td>27</td>
<td>22</td>
<td>49</td>
<td>64.29%</td>
<td>73.33%</td>
<td>68.06%</td>
</tr>
<tr>
<td>&lt; 70%</td>
<td>15</td>
<td>8</td>
<td>23</td>
<td>35.71%</td>
<td>26.67%</td>
<td>31.94%</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td><strong>42</strong></td>
<td><strong>30</strong></td>
<td><strong>72</strong></td>
<td><strong>100%</strong></td>
<td><strong>100%</strong></td>
<td><strong>100%</strong></td>
</tr>
</tbody>
</table>

Table 35. Number and percentage of the types according to their percentage of construction.

For the following tables I have considered that the nine companies that have not answered this question form part of the <70% category.

<table>
<thead>
<tr>
<th>Percentage construction</th>
<th>Yes</th>
<th>No</th>
<th>Total</th>
<th>% YES</th>
</tr>
</thead>
<tbody>
<tr>
<td>➢ 69%</td>
<td>36</td>
<td>13</td>
<td>49</td>
<td>73.47%</td>
</tr>
<tr>
<td>&lt; 70%</td>
<td>20</td>
<td>12</td>
<td>32</td>
<td>62.50%</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td><strong>56</strong></td>
<td><strong>25</strong></td>
<td><strong>81</strong></td>
<td><strong>69.14%</strong></td>
</tr>
</tbody>
</table>

Table 36. Number and percentage of the types of companies with environmental policy according to their percentage of construction.

<table>
<thead>
<tr>
<th>Percentage construction</th>
<th>Yes</th>
<th>No</th>
<th>Total</th>
<th>% YES</th>
</tr>
</thead>
<tbody>
<tr>
<td>➢ 69%</td>
<td>34</td>
<td>2</td>
<td>36</td>
<td>94.44%</td>
</tr>
<tr>
<td>&lt; 70%</td>
<td>18</td>
<td>2</td>
<td>20</td>
<td>90.00%</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td><strong>52</strong></td>
<td><strong>4</strong></td>
<td><strong>56</strong></td>
<td><strong>92.86%</strong></td>
</tr>
</tbody>
</table>

Table 37. Number and percentage of the types of companies with any EMS according to their percentage of construction.
<table>
<thead>
<tr>
<th>Percentage construction</th>
<th>Yes</th>
<th>No</th>
<th>Total</th>
<th>% YES</th>
</tr>
</thead>
<tbody>
<tr>
<td>≥ 69</td>
<td>27</td>
<td>9</td>
<td>36</td>
<td>75.00%</td>
</tr>
<tr>
<td>&lt; 70</td>
<td>10</td>
<td>10</td>
<td>20</td>
<td>50.00%</td>
</tr>
<tr>
<td>Total</td>
<td>37</td>
<td>19</td>
<td>56</td>
<td>66.07%</td>
</tr>
</tbody>
</table>

Table 38. Number and percentage of the types according to their percentage of construction with ISO 14001.
6 Analysis and Interpretation of results

6.1 INTRODUCTION

This chapter is based on the graphical representation, analysis and interpretation of the data obtained from the survey that was conducted to different construction, manufacturing and engineering companies around Europe. In Annex III all the tables are attached together with all the graphics of the obtained results.

The interpretation is structured question by question, attaching to each one the graphs obtained. Through it we intend to characterize both the operation and implementation of the EMS, and of the QMS. The analysis is carried out at the end of each thematic block of the survey, plus one which is situated at the very beginning of it referring to the participation. Then, at the end of the whole thematic block there is a last analysis on the typology and size of the companies.

The graphs shown were obtained from the tables in section 5, which refers to the results. For the design of the graphics that are included in this section, we have used the Microsoft Excel program. As in the statistical treatment of the data we have equally worked with two decimal places, though in some graphics it has been adopted another solution that does not include the use of decimals because of some visual issues that may have provoked the difficulty in the understanding of the graphs (see graphics 12, 51, 58, 59 and 60). In open questions 8 and 24 it has not been possible to represent graphically the results, since the wide variety of responses impeded it, and therefore we have directly gone through the analysis of these two questions.

Once the graphics are represented the results are interpreted so that an analysis of them is provided when finishing each block of the survey: introduction, general aspects, QMS and EMS. This process is equally repeated for the participation, and the size and typology of the companies. As explained in chapter four, the specific results of Slovenia are compared with those in the study by PhD Jana Šelih in 2006 [56], being this the reason that justifies why the results of this country have been separated from those of other countries. Both in the interpretation and analysis we have rounded the results with the aim of working without decimals.

Hence, the procedure throughout this chapter is going to be the following:

• Firstly, interpretation of global results (purple column).
• Secondly, interpretation of the differences or similarities between the specific case of Slovenia and that of the rest of the countries.
• Then, global analysis of the results that have been interpreted at the end of each block in the survey.
• Finally, evolution of the specific case of Slovenia at the end of each block regarding the previous study that underwent Jana Šelih in 2006, Environmental management systems and construction SMEs: a case study for Slovenia [56].

During the development of this analysis it arose the necessity of justifying some data that were observed throughout the study that is the difference in some percentages between the case of Slovenia and that of other countries. In order to justify this difference we decided to include at the end of this chapter some graphics together with an additional analysis. Firstly, we distinguished between the obtained results of EMS and QMS depending on whether companies are small and medium or large, and also according to their typology, that is whether they are construction, material production or engineering companies.

Before these analyses we will start by referring to the participation of companies in the present study:

![Graphic 7. Percentage of questionnaires answered for each version.](image-url)
A total of 54 questionnaires have not been answered, a number that represents 40% of the whole of the surveys that were sent, as opposed to the 81 questionnaires that were answered, which represents a 60%. For the Slovenian version the percentage of abstinence was 36%, while in the case of the English version the result has been increased up to a total of 45%.

Three different cases can be differentiated from the 54 questionnaires that were not answered. The first one refers to a couple of companies that gave the questionnaire back for being in a state of bankruptcy. Then, a total of 22 questionnaires were returned in blank or half answered, being this the reason why they were not taken into account when making the statistical treatment. Finally, 30 questionnaires were not even opened, or at least no reply was received.

### 6.1.1 Analysis of responses

As observed, the percentage of responses in the case of the Slovenian version has been higher (64%) in comparison to that of the English one (55%), something that can be explained according to a few reasons, being the first one the language and secondly the type of the selected company for each version. The mere act of sending the questionnaire in the language of a certain country contributes to the major involvement and participation of the respondent, and even if English is used worldwide and most companies work internationally with it, it can be noted that the number of responses for
this version of the questionnaire is reduced. It is also important to highlight the fact that there has been greater diversification of the companies that have answered the Slovenian version, pointing out to small and big companies, and consequently the communication pollster-company has been easier and more fluid, generally.

By contrast, the English version of the questionnaire has been sent to large companies with large volume of works and billings, which has made it more difficult the contact and communication with the person in charge of the specific area of study we are applying for, that is, environmental management, since in order to get a specific email online forms that are lost along the way must be completed first.

In the case of the 22 questionnaires that were returned in blank, it seems to be very probable that the questionnaires did not reach the right person in charge of this specific field of study, that the company in question was not interested in the study, or even that the company itself did not count with any kind of EMS measurements, so they opted to look and not answer despite ensure anonymity of the respondents and companies.

The number of questionnaires that have not even been opened, a total of 30, has been equally justified, though it should be highlighted that most of them came from the English version. Then, another reason that explains this, apart from what we have just said above, may apply to the fact that very probably the surveys did not reach the right person for the already mentioned difficulty in contacting and communicating with large companies.

In 2006 a total of 56 surveys were sent to different construction, manufacturing and engineering Slovenian companies, from which 26 were answered entirely, so this means that 47% of the questionnaires were answered [56]. Consequently, and thanks to a higher percentage of participating companies in this study, we could consider that the value of the obtained results is more significant and, therefore, more relevant in comparison to previous studies in which a smaller number of companies were surveyed.

6.2 PART 1 WEB SURVEY: INTRODUCTION

Question 1. Country/ies where the company works.
The country with greater participation is, obviously, Slovenia, since more than 59% of the surveyed companies come from this country, followed by Austria (11%), Italy (11%), Croatia (8%) and finally Spain (6%). We should take into account that 2% percentage refers to the category of “others”.

As expected and previously mentioned, the 100% of the Slovenian version of the questionnaire was completed in this country. For the English questionnaire it is noticeable the contribution of Austria, which is the country that collaborates the most (31%), followed by Italy (26%), Croatia (20%), Spain (14%) and finally we should mention a percentage of 6% included in the category of “others”.

### Graph 9. Percentage of version questionnaire answered for each country.

### Graph 10. Percentage of participation of each country in the development of this study according to the version of the survey.
Question 2. What is your position in the company?

Graphic 11. Percentage according to the position in the company of the person who answered for each questionnaire.

Graphic 12. Percentage of position in the company of the person who answered by each company.
The largest number of responses has applied to projects managers, a 26%, and to responsible of environmental management, 22%, followed by top management positions, 17%.

It is quite noticeable a small difference between Slovenia (12%) and the rest of the countries (38%) in relation to the percentage of answered questionnaires by the people responsible for environmental management. While this 38% represents the highest percentage in the case of companies that do not operate in Slovenia, in the precise case of this specific country we should say that the vast majority of the answers, represented by a percentage over 55%, were sent by project manager and top managements.

6.2.1 Analysis of introduction

The number of questionnaires that were answered is 81, though in question 1 there were answered 84 questionnaires since this specific question has multi choice options. This difference of 3 comes precisely from the English questionnaires, and it can be justified by saying that 3 companies do not only operate in the country of origin, but also in countries like UK, Poland, South America and even Slovenia.

Being such a small number, both the case of “others” (UK, Poland, etc) and that of Slovenia have been considered for the purposes of statistical analysis as a single response lieutenant result per principal country where they operate.

A total of 77 questionnaires were sent to Slovenian companies, while 58 were sent to the rest of the countries, so it does not really come as a surprise that the greater representation is made by Slovenia. The contribution of Austria is also to be highlighted, though the less participation in the study is detected in Spain, mainly for the two reasons that were explained previously: the language of the survey and the type of the company.

In reference to the position that the person who was surveyed has in the company, the highest percentage is represented by people who are responsible of the environmental management area. This denotes the importance given by companies to develop themselves in a sustainable manner by not only putting in charge experts on this specific topic, but also by even creating a separate department.

It is well known that nowadays society is more concerned about environmental issues, taking the control of our environment and resources, a fact that is equally reflected in companies, as we have proved through this study. In reference to this we should point out to previous work that was developed before sending the web survey to
the different companies, since the aim was not to send the questionnaire to the company through a general email, but to contact directly with the person responsible for environmental management. In order to get the specific emails companies were firstly sent another email in which the contact of the person in charge of such area was asked.

Having said this, we should now establish a very remarkable difference between Slovenia and the rest of the countries, as the percentage of the person who answered are the environmental responsible, for each case changes from 38% to 12%. It seems to be evident that the typology of the company for each case as well as its size provokes variations in the percentage. While larger companies have at their disposal specific people in charge and departments, this does not always happen in small and medium-sized companies. In this last case this specific task is delegated to top managements or project managers, giving a considerable importance to the environmental issue.

In comparison with the previous study that took place in 2006 we should conclude by mentioning the fact that these two questions that have been analyzed in this specific point were not analyzed then.

6.3 PART 2 WEB SURVEY: GENERAL

Question 3. Please, state the activities of your company and approximate share of individual activities.

Comment: Please tick the activity your company carries out (on square located extreme left) and provide the percentage for each activity in %, with respect to your total scope of activities.
The vast majority of the companies that have contributed to this study are construction companies, specifically 67% of them, followed by companies that produce construction materials (16%) and engineering companies (11%). In the category of “others” it is noticeable the presence of companies dedicated to energy, treatment of water and design.
The particular case of Slovenia the percentage of construction companies is less, nearly 10%, if compared with other countries, and therefore the percentage of companies dedicated to the production of construction materials increases.

**Question 4. Please state the number of employees of your company.**

**Graphic 15. Percentage of the number of employees per country/ies.**

**Graphic 16. Percentage of the number of employees by company.**

The biggest percentage, 33%, is found in companies with a medium of 50 to 250 workers, followed by companies with 250-500 workers (28%), and those of 0-50 workers (22%). Companies with more than 500 workers represent the 18% of the study.

The most representative percentage of obtained results both to Slovenian companies and those from other countries corresponds to the interval of 50-250 workers. The difference between the two questionnaires is shown in the rest of the percentages. While in Slovenia the second place is reserved for companies with 0-50 workers, in the rest of the countries this place is place is for companies with 250-500 workers.
Question 5. Please, provide the approximate number of permanent and temporary production/storage locations in your company.

In the case of permanent locations it is remarkable the percentage that corresponds to the interval 1-5, which does almost represent a 70%. For temporal locations this percentage is more widely distributed, decreasing for this same interval up to 46%.
In Slovenia is even bigger the percentage of permanent locations in the interval of 1-5, increasing up to 80%, as opposed to the rest of the countries, where it decreases up to 56%, a pattern that is followed by temporal locations. In this case in the interval 1-5 it should be highlighted the percentage of Slovenia, almost 56%, while the highest percentage for the rest of the countries is found in the third column of the table (>10), which represents a 52%.

6.3.1 Analysis of general aspects

When this study started the aim was firstly to make an analysis on the implementation of EMS in construction companies. After this, the study was extended taking into account more typologies of companies, as the engineering ones or those that are dedicated to the production of construction materials, was done. However, the majority of the surveys were sent to construction companies, since they are the companies with a stronger influence in the construction process [6, 18].

In order to obtain this majority of construction companies, a specific research was developed to give priority to this type of enterprises, not forgetting about some other important processes as the production of materials and the engineers. That is the reason why the questionnaire was sent in a lesser extent to companies of this type.

The percentage referring to construction companies in the Slovenian questionnaire is 10% inferior to the sum of the rest of the countries. As explained in the introduction of this chapter and in chapter number 5 of this thesis, an attempt to a wider study was done in the case of Slovenian companies by sending the questionnaire to more different types of companies, specifically 77 surveys. That is why the percentage of manufacturing and engineering companies is more elevated in comparison to the rest of the countries where the selection of companies was more focused on more traditionally construction enterprises.

In reference to the number of workers and if we considered as small and medium-sized companies those that count with a number of workers between 0-250 [56], then these sum a total of 56% of this study. This is of relevance in the results that will be discussed later on as firms with a high number of workers, work volume and billing have a tendency to have higher implementation of EMS and QMS [3, 27 56, 62]. If we analyse this percentage we notice that this is precisely the case of Slovenia which increases this percentage, since small and medium-sized companies represent 63% of the study, while in the other countries it represents 44%. This is normal given the fact
that Slovenia is a small country where small and medium-sized companies predominate and, therefore, the search criteria for the companies that operate outside Slovenia was different, giving more importance to larger construction companies.

As a summary, it might be stated the fact that while in Slovenia small and medium-sized companies predominate, more prestigious and well-known firms prevail in other countries. This data will be relevant when considering the percentage of implementation of an environmental management and quality system, as discussed below.

It is equally justified in this same manner what happens in the type of localization of the companies. In Slovenia, for instance, more than 60% are small and medium-sized companies, which explains why they have a fewer number of locations, both temporal (>10 only 15%) and permanent (>10, 6%). By contrast, in the case of large European companies they have a much more elevated percentage of >10 temporal locations, 52%, because they have a higher number of works distributed over the geography where they have more influence.

Consequently, we could say that in the previous study of 2006 the percentage of Slovenian construction companies increased to 76%, more than 63% of the present study [56]. This decrease is normal due to the fact that the questionnaire was not only sent to construction companies, but also to companies of a wider typology. While in 2006 a total of 26 companies were surveyed, in the present study the number has increased up to 49 [56]. In reference to the type of companies, there has not been any difference since 2006, when small and medium-sized companies did also prevail, something that can be represented by a percentage of 62% [56], a very similar value to the one that has been obtained in this study, which was 63%.
6.4 PART 3 WEB SURVEY: QUALITY

Question 6. Has your company established (any kind of) quality policy? Have you determined/specified the goals and procedures?

Almost 90% of the surveyed companies, namely an 89% have established any kind of quality policy.

There is not a significant difference between Slovenia and the rest of the countries, since in both cases the vast majority of the companies have answered with a positive response by confirming the establishment of a quality policy.
Question 7. Has your company implemented any type of quality management system or program that would enable to conform to the quality management?

From the 89% of the companies that had already established a quality policy, most of them, 85%, have opted for the implementation of ISO 9001.

There is no difference between the two versions of the questionnaire, since throughout Europe is remarkable the selection of ISO 9001 as quality management system.

Question 8. If you have established a certified QMS (ISO 9001-compliant), who was the certification body?

From the total of possible answers that could have been collected for this question, 41 for Slovenia and 28 for other countries, only 29 and 14 answers were received, respectively, since a big proportion of the companies surveyed on this question decided...
not to answer it. Then, we could affirm that this kind of question is not functional, as the number of abstentions has increased considerably.

Despite this negative aspect, there is actually a difference between Slovenia and the other countries. While in Slovenia the certification body is represented by companies like SIQ and Bureau Veritas, in the rest of the countries this is represented by companies like SGS and DNV.

**Question 9. Please, provide an estimate for the percentage (share) of your previously existing QMS that could be kept during the implementation of the ISO 9001-compliant standard.**

---

**Graphic 23. Percentage of previously existing QMS that could be kept during the implementation of the ISO 9001 for each questionnaire.**

**Graphic 24. Percentage of previously existing QMS that could be kept during the implementation of the ISO 9001 by country.**
A total of 38% of the companies have taken advantage of the quality management system that they used before establishing ISO 9001. On the contrary, almost 16% of companies that have established ISO 9001 implemented it without having any other kind of system previously.

This percentage tendency is maintained both in Slovenia and the other countries without highlighting any relevant difference.

**Question 10. Has your scope of acquired works increased since you have implemented the ISO 9001 standard?**

![Graph 25. Percentage of acquired works increased since the implementation of the ISO 9001 for each questionnaire.](image)

![Graph 26. Percentage of acquired works increased since you have implemented the ISO 9001.](image)

On one hand, 68% of the companies highlight the importance of having implemented a QMS, since it is thanks to this that their number of works have been increased. On the other hand, there is a percentage of 32% of the companies that have not noted any kind of repercussion in their volume of work when implementing ISO 9001.
This tendency is maintained both in Slovenia and the rest of the countries without any relevant difference.

**Question 11. Why have you decided to establish an ISO 9001 compliant QMS?**

Please add important reasons for you, if they are not listed.

Comment: please rank the below listed reasons according to perceived importance; 1=most important, 5= least important.

**Reasons to establish ISO 9001. Slovenian companies**

Graphic 27. Percentage of reasons to establish ISO 9001 in Slovenian companies.
There is a certain similarity between the percentages that represent the reasons for establishing the ISO 9001. A 38% of the surveyed companies pointed out to the main reason as being the improvement of transparency in the company management, though
there are some others that justify its establishment according to their ambition for satisfying the clients’ demand and reducing the costs. Then we have the category of “others”, with a residual percentage as no company gave to it the maximum punctuation (one or two).

At this respect there is a difference between the case of Slovenia and that of the other countries. In the former case the main reason points out to the improvement of the transparency in the company management (57%), while in the latest case it points out to the reduction of the costs (33%), being this last percentage the highest one for the specific case of those companies that operate outside of the Slovenian territory.

**Question 12. Will your company try to establish an ISO 9001-compliant quality management system in the near future?**

![Graphic 30](image)

Graphic 30. Percentage of companies that will try to establish an ISO 9001 for each questionnaire.

![Graphic 31](image)

Graphic 31. Percentage of companies that will try to establish an ISO 9001.

42% of the companies that do not have ISO 9001 have the intention of implementing it in a near future. It is remarkable the percentage of technicians that
answered this question by selecting the “no comment” option, specifically a 25% of the companies that do not have ISO 9001.

This time there is a very significant difference between Slovenia and the rest of the countries, especially in the “no” answer. In Slovenia this answer represents a 38%, while in the other countries it is represented by a 25%. In general we should say that there are more companies in the process of obtaining ISO 9001 outside Slovenia, a 13% more.

**Question 13. If you do not hold an ISO 9001-compliant QMS, please provide and rank the reasons why you have not decided to implement the ISO 9001 standard.**

*Comment:* please rank the reasons according to perceived importance, 1=most important, 5=least important.

![Graphic 32. Percentage of the reasons why companies have decided not to implement ISO 9001 in Slovenian companies.](image)
Reasons for not implementing the ISO 9001.
European companies

Graphic 33. Percentage of the reasons why companies have decided not to implement ISO 9001 in European companies.

Reasons for not implementing the ISO 9001

We are in the process of ISO 9001 implementation
There is no need to implement this standard in our sector
Having an ISO 9001 compliant QMS is not a significant competitive advantage
Costs of the certification are too high
Other

N/A 5 4 3 2 1
For those companies that have not established ISO 9001, the main reason for not implementing it has been that the cost of the certification is too high. In fact, the 55% of the responsible technicians have given to this reason the highest punctuation (1). The second most frequent reason has been considering that obtaining this certification does not mean any significant advantage (25%). This percentage is very similar to the third reason provided by the companies, which refers to those companies that are in the process of obtaining ISO 9001 (22%).

The difference between Slovenia and the rest of the countries lies in the percentage that represents this last reason that is, being in the process of obtaining the certification. While in the first case this is not conceived as a priority, in the second case the highest punctuation (1) is given to this aspect by a 33% of the companies.

**Question 14. Do the clients (investors) require an established QMS in order to get the contract?**

![Graphic 35. Percentage of clients who require QMS to get the contract for each questionnaire.](image)
Only a 16% of the surveyed technicians answer that in the very moment of signing a contract they are not required by the client to have established a quality management system.

In the case of Slovenia and the rest of the countries this percentage is kept with variations in the percentage distribution of answers “yes” and “not often”.

6.4.1 Analysis of the results of quality management systems

In this study it is demonstrated that the majority of the companies of the construction sector have established some kind of quality management system, and more specifically the system that has been implemented is ISO 9001. This is the main reason why we have focused our attention on the study of this certificate and not of any other, since it is the most used and normalized in a European level, as it is shown in the obtained results.

Lots of technicians value positively having had any other kind of quality system before the implementation of ISO 9001 in order to obtain the final certificate more easily. The conclusion to which we reach is that having precedents in the implementation or establishment of a quality management system before obtaining ISO 9001 contributes highly to the implementation of this last certification [56]. However this, this is something not really necessary, since a wide number of companies did directly implement ISO 9001 directly.

Once a QMS is implemented the responsible technicians comment on the attainment of this certificate as the reason why the number of their works and clients has increased. In fact, nowadays many of the works destined to construction companies are promoted from the public sector [5], which means that in order to obtain this works from a tender, some criteria such as having an implemented quality system is very well valued and taken into account. Another objective that encouraged companies to adopt ISO 9001 points out, apart from the increase of works and clients, to their aim to improve the transparency of the company and reduce the costs. In this last reason a curious phenomena happens when comparing Slovenia and the rest of the companies. In both cases the reduction of costs is very important, but in the case of Slovenia the higher percentage has been for “2” instead of being for “1” (58% and 13%, respectively), with a total of more than 70% if we sum both percentages. In the case of the rest of the countries the percentage of the sum of “1” and “2” is 65%, but in this case the
percentage of “1” is much more elevated (33%). Then, we could confirm that despite the visual difference that can be appreciated, percentages are not so different.

This little anomaly can be applied to the difference between the surveyed companies. In Slovenia, where a high number of small and medium-size companies predominate, “reduction of costs” is a very important reason for the establishment of ISO 9001, though it is not a priority. In the particular case of the rest of the countries, where there is a major concentration of large companies, this was precisely the most determinant reason for the implementation of ISO 9001. Large companies with an elevated number of workers and localizations need to reduce their costs and have a major control over the different procedures and documentation.

All these reasons and more specially the increase of the number of works and clients have encouraged companies to think about the implementation of ISO 9001 in a near future, as more and more the necessity of implanting thin certificate in the construction companies is becoming more evident.

In order to evaluate this result in a rigorous manner it would be necessary to monitor throughout time to determine if companies that answered positively had already implemented ISO 9001 or not. As time goes by, we will also be able to contemplate the evolution of the percentage of companies that have answered “no comment”. This answer might be due to the fact that the technicians that were surveyed do not know if the implementation it going to take place in a near future or because they did not know the position of the company in reference to the adoption of ISO 9001.

As in the case of the reasons that encouraged companies to implement ISO 9001, we observe a difference between the different typologies and size of the companies. For instance, in Slovenia we notice a major percentage of “no” answers that comes from small and familiar companies that do not really need the implementation of this certificate.

It is because of this that companies do generally go for implementing a QMS, mainly the ISO 9001, specially in enterprises with a wider number of workers and localizations, as observed in the last question of this block, where only 16% of the clients do not require this kind of certificate at the moment of signing a contract with a company of the sector.

In 2006 a 88% of the 26 surveyed companies that had already established a QMS went for the implementation of ISO 9001 [56], a very similar percentage to the one obtained in this study, around 84%. It does also remain constant the result of the
companies that took advantage of a quality management system previous to ISO 9001 as well as the percentage of clients that are not interested in this certificate.

As we observe from this study the percentage of companies that have at their disposal their own QMS before having implemented the ISO 9001 is of almost 83%, which means that it has increased in comparison to the one obtained in 2006. As far as the clients’ requirements are concerned, however, the percentage is very similar to the one from year 2006, and only 16% of them do not require this certificate for closing the contract.

6.5 PART 4 WEB SURVEY: ENVIRONMENT

Question 15. Does your company hold an environmental management policy?
Have you determined the environmental goals and procedures?

Almost 70% of the surveyed companies, that is 69%, have already established some kind of environmental quality policy management system.
This percentage is even more explicit in the case of companies that work outside Slovenia, increasing up to 78%. However, in this Slavic country this percentage descends to 63%.

**Question 16. Please provide the areas (of environmental management) where your company places the focus. If there are areas you focus on, but they are not listed, please add them to the list.**

Comment: Please indicate the rank of importance (as you perceive) of listed areas in the squares on extreme right. If you focus to areas that are not listed in the table, please provide (and rank) them as well. (1=most important, 7=least important).

**Areas where companies place the focus.**

**Slovenian companies**

[Graphic 39. Percentage of areas where companies place the focus in Slovenia.]
Areas where companies place the focus.
European companies

Graphic 40. Percentage of areas where companies place the focus in European companies.

Areas where companies place the focus

Graphic 41. Percentage of areas where companies place the focus.
Although a percentage of 100% is observed in the category corresponding to “other”, exclusively answered with option “one”, this is not the area where companies put their emphasis the most, since the relation number of answers obtained/punctuation points out to “waste control” as being representing this aspect (category of “other” did only obtain 4 punctuations while the rest of the options obtained 31). In terms of the percentage of “1” answers this is followed by energy savings (38%), recycling materials (30%), noises prevention (23%) and air pollution control (21%).

These results are very similar both in the case of Slovenia and the rest of the countries despite that visual difference that can be appreciated in the percentage of “recycling of materials”, since such difference is not really so unequal. While in the Slavic country this is the second more punctuated area with “1”, 52%, in the other countries this percentage descends to 13%, though the selection of “2” is the second biggest punctuation. The sum of the two most elevated punctuations, that is “1” and “2”, in “recycling materials” in the case of Slovenia is 64%, while in the rest of the countries is nearly 62%.

**Question 17. Is there a protocol how the project documentation in the execution phase should be prepared/extended? (In order to account for the environmental issues).**

![Graphic 42. Percentage of companies with a protocol for each questionnaire.](image-url)
75% of the surveyed companies have at their disposal some protocol regarding the manner in which the project documentation in the execution phase should be prepared.

There is a difference between Slovenia and the rest of the countries specifically favourable to this last group.

**Question 18. Has your company established any kind of environmental management system, or other program that could ensure the conformance to the environmental policy?**

---

**Graphic 43. Percentage of companies with a protocol.**

---

---

**Graphic 44. Percentage of companies with EMS for each questionnaire.**
From the 70\% of companies that had established an environmental management policy the majority of them, 66\%, have decided to implement ISO 14001. In addition to this, a total of 94\% of the companies have established some kind of EMS.

There is no relevant difference between the two versions of the questionnaire. The vast majority of the European companies have established some kind of EMS, though they generally choose ISO 14001 as the environmental management system, which seems to be the one with more followers.

**Question 19. Have you assigned the responsibility for the EMS to a member of the top management?**
 Approximately in 70% of the surveyed companies the person in charge of environmental management is a member of the top management of the company.

The difference between Slovenia and the rest of the surveyed countries is near to 11%.

**Question 20. Are the existing QMS and EMS integrated?**
More than 80% of the surveyed companies do have integrated both a quality management system and an environmental management system.

The percentage of Slovenia appears to be very similar to that for the rest of the countries that is 79% and 83%, respectively.

**Question 21. How much of the previously existing EMS could you keep at the establishment of the ISO 14001-compliant EMS?**
27% of the companies have taken 100% advantage of the environmental management system that they used previously at the very moment of the establishment of ISO 14001. On the contrary, almost 14% of the companies that have established ISO 14001 did implement this certification without having any other previous system.

Then, the percentage for Slovenia and the rest of the countries is very similar. In the former case a total of 85% companies did already have an integrated system before implementing ISO 14001, and for the latest case this percentage changes to 88%.

**Question 22. Do you have a list of potential problems related to environmental management?**

**Graphic 51. Percentage of the previously existing EMS that could be kept at the establishment of ISO 14001.**

**Graphic 52. Percentage of companies with a list of potential problems for each questionnaire.**
Around 67% of the surveyed companies have a list of potential problems in relation to the environment.

We should say that for this question there is a difference in the percentage of 14% minor in the case of Slovenia if compared with the other countries.

**Question 23. Are you following the changes of the environment-related legislature?**

**Do you have a defined and documented procedure for this issue?**

![Graph showing the percentage of companies following the changes of the environment legislature for each questionnaire.](image)
More than 64% of the surveyed companies follow the changes of legislation that are in connection with the environment.

The tendency that was observed in the previous question in reference to the results for Slovenia and the rest of the countries is maintained. It is specifically in this question where the difference between both cases increases to 18%, being favourable to those companies that work outside Slovenia.

**Question 24. If your organization has not yet established an EMS, or if it is not ISO 14001-compliant, please list the elements of environmental management that already exist:**

From a total of answers that could have been obtained for this question, 29 for Slovenia and 15 for other countries, only 5 and 2 answers were received, respectively. Part of the responsible technicians that were surveyed decided not to answer this question, so we might conclude that this type of question is not functional according to the high number of abstentions. From these conclusions we could also infer that some companies that do not have at their disposal ISO 14001 are not really interested in aspects regarding the environment.

Despite this negative fact the most repeated answer has been “everything requires by law”.
Question 25. Will your company try to establish an ISO 14001-compliant EMS in the near future?

![Graphic 56. Percentage of companies which try to establish ISO 14001 in the near future for each questionnaire.](image)

68% of companies that do not have at their disposal ISO 14001 have the intention of implementing it in a near future. It is quite remarkable the percentage of technicians that answered to this question choosing the “no comment” option, which represents almost 16% of the companies that do not have this certificate yet.

There is a slight difference between Slovenia and the rest of the countries especially in the “no” answer. In Slovenia “no” represents 17%, while in the rest of the countries is 13%. Consequently, in terms of percentage there are more companies in the process of obtaining ISO 14001 outside Slovenia than inside of it, that is, almost 8% more.

Question 26. Do you see (perceive) any barriers in the ISO 14001-compliant EMS implementation? Please rank the barriers listed below according to the perceived importance.

Comment: 1=most important, 5= least important.
Study on Environmental Management Systems in construction companies

Barriers in the ISO 14001. Slovenian companies

Graphic 58. Percentage of barriers in the ISO 14001 in Slovenian companies.
# Study on Environmental Management Systems in construction companies

## Barriers in the ISO 14001. European companies

<table>
<thead>
<tr>
<th>Barriers</th>
<th>Percentage</th>
</tr>
</thead>
<tbody>
<tr>
<td>Lack of pressure for the governmental/legislative side</td>
<td>27%</td>
</tr>
<tr>
<td>Lack of support/demands from the customer side</td>
<td>24%</td>
</tr>
<tr>
<td>Large costs of the EMS establishment</td>
<td>4%</td>
</tr>
<tr>
<td>Sub-contracting creates problems in the EMS implementation</td>
<td>22%</td>
</tr>
<tr>
<td>Lack of environmentally friendly technologies and materials</td>
<td>23%</td>
</tr>
<tr>
<td>Inadequacy of standards (different interpretation in construction industry)</td>
<td>25%</td>
</tr>
<tr>
<td>Complicated documentation process</td>
<td>22%</td>
</tr>
<tr>
<td>Lack of support from workers' side</td>
<td>31%</td>
</tr>
<tr>
<td>Poor environmental culture among competition</td>
<td>24%</td>
</tr>
<tr>
<td>Separate design and execution in construction process</td>
<td>31%</td>
</tr>
<tr>
<td>Nobody (no other construction company) starts first</td>
<td>32%</td>
</tr>
</tbody>
</table>

Graphic 59. Percentage of barriers in the ISO 14001 in European companies.
Study on Environmental Management Systems in construction companies

Barriers in the ISO 14001

Graphic 60. Percentage of barriers in the ISO 14001.
It is necessary to highlight two big barriers over the rest: “large cost of the EMS establishment” and “complicated documentation process”, with percentages of 47% and 37%, respectively. Not so important barriers are: “nobody (no other construction company) starts first”, “inadequacy of standards” (different interpretation in construction industry), and “lack of support from workers’ side”, with answers of “1” that vary from the 1% for “nobody (no other construction company) starts first”, to the 14% for “lack of support from workers’ side”.

There is a remarkable similarity in the percentage of the different barriers to which the technicians were exposed to if we compare the case of Slovenia with that of the other countries. In both cases the first position is occupied by “large cost of the EMS establishment”, with almost identical percentages. This is followed by “complicated documentation process”, which is the second barrier with a higher punctuation for both cases, though in Slovenia this percentage is bigger than in the rest of the countries (44% and 33%, respectively).

6.5.1 Analysis of the responses of environmental management system

In this study it is demonstrated that the majority of the companies that work in the construction sector have established some kind of environmental management system, that is a 93%, being the implemented system per excellence the ISO 14001 in 66% of the surveyed companies. This data increases still more in the case of large European companies, since the medium percentage of establishment of these systems is elevated up to nearly the 96%, while in Slovenia, where there is a bigger percentage of small and medium- size companies with varied typology the percentage decreases to the 90%.

From this we come to the conclusion that generally large companies prefer to establish an environmental management system. By contrast, in companies that are not only devoted to construction this percentage decreases.

It remains evident that ISO 14001 is not the only environmental management system that is being used, though as it is proved in this study it is the most widely used and standardized in European companies. In fact, around 27% of the surveyed companies decided to choose another management system as the EMAS (the EU Eco-Management and Audit Scheme). However this, we chose to devote the entire study to the analysis of ISO 14001 given the fact that this system is most common among companies, with 70% of users, a percentage that was known before but that we have proved through this thesis.
Apart from establishing and implementing an environmental management system most companies, and especially the largest ones, have a specific protocol of how the project documentation in the execution phase should be prepared/extended in order to account for the environmental issues, and so they have associated the person in charge of environmental management with a very relevant position within the company, even creating their own departments. The reason that explains this is that each day there is more and more concern about environmental management, an issue where more emphasis is put especially in large companies, as we have been going through in this project.

Among the companies that have decided to establish some of the different environmental management systems we should point out to the case of those surveyed technicians that consider that the most important areas for every companies are, in order: waste control, energy savings, recycling materials, noise prevention, pollution control, bio treatment plant and solar cells (belonging these two last to the category of “others”), something that can be explained according to several reasons.

Firstly, since quantities of the construction and demolition waste produced are large, its control can contribute not only to a better quality environment, but also to a reduction of costs. Secondly, the different regulations on construction and demolition waste make this issue more attractive to the construction industry in general [56]. Energy savings is the second most important environmental issue for the companies participating in the survey. Again, this topic has a numerous related legislation and therefore they yield enhanced motivation to rank it as a high priority. Thirdly, the issue of recycling of materials appears once more, which is considered as a priority according to a more concerned and sensitized society. It is because of this that companies adapt themselves to these requirements, that is, conserving and reusing our resources. Last but not least we find noise prevention and air pollution, with very high percentages for “1” and “2”, as being very important areas in cases such as big work in urban cores.

It should also be noted that more than 80% of the companies holding the ISO 14001 certificate are also holding the ISO 9001 certificates. This confirms that it is easier to establish an EMS if the framework set by the standardized QMS is already in place. Therefore it is worthwhile to encourage the organisms to start with the implementation of a QMS as the first step to the environmental management system.
In addition to this, lots of technicians viewed positively the idea of having had any environmental management system before the implementation of ISO 14001 in order to obtain the final certification in an easier way.

Hence, the conclusion to which we reach is that having antecedents in an implemented or established quality management system before obtaining ISO 14001 helps considerably to the implementation of this last certification, though it is something not strictly necessary, since 14% of the companies decided to implement it directly.

The next question, question number 22, was addressed to find out how the respondents dealt with their own environmental problems. The survey results show that 67% of all respondents compiled a list of environmental potentially problematic issues. It is obvious that all responding organizations holding the ISO 14001 certificate have such list, as this is the standard requirement [56]. Of those companies that have already established an environmental management system different from ISO 14001, most of them do also have a list of environmental potentially problematic issues. As opposed to this, among the companies that have not establish any EMS only 2 of 27 have this list, and that is why the global percentage decreases to a 67%.

Similar results are obtained in the case of companies that follow the different legislature changes in relation to the environment, with a total of 65% of the whole quantity of companies that have been surveyed. It remains evident that companies that have at their disposal the ISO 14001 or any other EMS do monitor continuously the laws in order to be up to date in relation to the current legislation.

Nowadays, there is a growing concern for our resources and the surrounding environment by the different societies and authorities, and that is why the majority of the companies prefer to implement an EMS and more especially the ISO 14001. Because of this, lots of companies that do not count with an EMS are struggling for the implementation of ISO 14001 in a near future, cause the necessity of adopting it is being more and more extended among companies of the construction sector, as proved in this study with the 70% of surveyed companies that have the intention of implementing it in a near future.

As in the case of ISO 9001, in order to evaluate this result it would be necessary to monitor throughout time to determine if companies that answered with “yes” have really implemented ISO 14001 or not. As time goes by we will also be able to see the evolution of the elevated percentage of companies that have answered “no comment”, represented by a 16%. This answer might be due to the fact that the surveyed
technicians might not know if the implementation will take in a near future or maybe because they did not know the position of the company in relation to the implementation of an EMS.

In reference to the possible barriers that can be encountered during the implementation of an EMS, the responsible technicians that have participated in this study have valued as the most significant the followings: large cost of the EMS establishment and complicated documentation process. It is interesting to note that in the respondents’ view there is enough pressure from the government in the shape of new regulations, and the general from of the ISO 14001 standard is not perceived as a major obstacle.

Then, the complete list according to the responsible technicians in order of importance is the following:

1. Large costs of the EMS establishment.
2. Complicated documentation process.
3. Poor environmental culture among competition.
4. Sub-contracting creates problems in the EMS implementation.
5. Lack of support/demands from the customer side.
6. Separate design and execution in construction process.
8. Lack of support from workers’ side.
9. Inadequacy of standards (different interpretation in construction industry).
10. Lack of pressure from the governmental/legislative side.
11. Nobody (no other construction company) starts first.

From this classification we can draw that the big barrier that is found by companies when implementing the ISO 14001 is a problem related to the procedure, that is to say, it makes reference to the cost and documentation in order to adopt such certificate. By contrast, the pressure exerted by clients should be a stimulus for the adoption of the ISO 14001. Others studies had a similar list [3, 56].

In 2006 a 77% of the surveyed companies (20 companies) had an established environmental policy [56], a result not so different from that obtained in this study, with a total of 31 companies that corresponds to a 63%.

This decrease in the percentage is justifies for having done a more numerous study of companies with a more varied typology and not just construction companies, so that the percentage of construction companies has changed from the 76% of 2006 [56] to the
62% of this study, and consequently the number of manufacturing and engineering companies has increased. Nevertheless, the percentage of companies that have implemented any kind of EMS once established this policy has increased.

There is a parallelism between the areas where companies are more focused on and the potential barriers that the technicians have found to establish the ISO 14001. The main reasons, similar to those of the study of 2006 are also present in this study of 2013. There is now a small evolution in the percentage of the importance that companies give nowadays to the recycling materials issue with regard to the year 2006, being now a priority.

The evolution in the establishment of an EMS by companies is very positive, as observed in the present study where the positive results that were obtained in 2006 are reaffirmed. In this previous study 14 of the 20 surveyed companies, a 70%, had already implemented any kind of environmental management system, and of those 6 that had not adopted it 4 of them had the intention of implementing it in a near future. In this study we have a total of 90% companies that have established any kind of EMS and, more especially, 65% of them have decided for ISO 14001 [56].

It is because of all this that we can confirm that the sequence of positive results that were obtained in 2006 continues nowadays in a constant manner and even increasing, as for example the percentage of companies that have implemented the ISO 14001 or any other EMS. While in 2006 this percentage of ISO 14001 was 60% and the percentage of implementation of some EMS was 86% [56], in this study, and even if the surveyed companies were of a more varied typology, this percentage has increased up to 65% for the ISO 14001 and 90% for companies that have implemented any other kind of EMS.

6.6 AUXILIARY GRAPHICS

6.6.1 Introduction

In this subsection nine graphics are attached that are used to understand and justify some of the results that were obtained in the different thematic blocks of the present survey and that are in relation to the QMS and, more specially, with the EMS of the different countries.

In order to obtain these data and the graphics that represent them each survey has been revised so that results could be established according to the size, and then repeating this process according to the typology.
These graphics have been created because of the necessity of justifying the differences in some questions between the case of Slovenia and the rest of the countries. So far, in the different analysis this difference of results has been justified according to the size of the companies (number of workers of the company), and the percentage of activity that they carry out (construction, material production and engineering companies). We are going to demonstrate this point.

### 6.6.2 QMS and EMS according to the size of the company

It has been considered that small and medium- size companies are those that have a number of between 0 and 250 workers [56]. Companies with more than 250 workers are referred to as large companies.

According to this criterion the two first graphics represent in percentage the number of small and medium- size companies (SMEs), as well as larger surveyed companies in this study. In the graphic we observe that there are three columns, one representing Slovenia, a second one representing other countries and the last one being referred to the sum of both cases that is, a global result.

#### Companies’ size

<table>
<thead>
<tr>
<th></th>
<th>Big companies</th>
<th>Small and Medium companies</th>
</tr>
</thead>
<tbody>
<tr>
<td>Slovenia</td>
<td>36,73%</td>
<td>63,27%</td>
</tr>
<tr>
<td>European</td>
<td>56,25%</td>
<td>43,75%</td>
</tr>
<tr>
<td>Global</td>
<td>44,44%</td>
<td>55,56%</td>
</tr>
</tbody>
</table>

Graphic 61. Percentage of SMEs and big companies.

### QMS

Now, the percentage of companies that have participated in this study and that have established the ISO 9001 according to their size is being represented. For each case (Slovenia, rest of the countries and global) we have three columns, being the first one for small and medium- size companies, the second one representing large companies and the last one being referred to the sum of both of them.
Study on Environmental Management Systems in construction companies

EMS

Besides results are represented in the three graphics that appear below that refer to environmental policies, companies with any EMS and finally companies with the ISO 14001, according to the size of the companies.

Graphic 62. Companies with ISO 9001 according to their size.

Graphic 63. Companies with an environmental policy according to their size.
6.6.3 EMS according to the typology of the company

Most of the companies that have participates in this study are construction companies, though it is also necessary to take into account the important participation and representation of material production and engineering companies in the present investigation. It is because of this that we have decided to study the difference between companies with an environmental policy, those that have adopted any kind of EMS and
finally those that have implemented the ISO 14001 according to the typology of the company.

A considerably big number of companies, as it is mentioned in question 3 of this study, carry out various or even the three types of work that were mentioned previously. With the only aim of differentiating between construction or not construction companies we have considered as construction companies those in which question 3 answered with a percentage equal or superior to 70% in that precise activity (>69 in graphics), and non construction companies those with a percentage lower than 70% in the construction activity (<70 in graphics).

In this first graphic it is being represented the typology percentage of surveyed companies in this study in the case of Slovenia, the rest of the countries and a global analysis.

In the following graphic it is being represented in different columns (red colour for construction companies, blue for non construction companies and purple for the global result) the establishment of an environmental policy, the establishment of any kind of EMS and the implementation of the ISO 14001 depending if the company is a construction company or not.
Graphic 67. Companies with an environmental policy depending on if they are construction companies or not.

<table>
<thead>
<tr>
<th>Percentage</th>
<th>&gt; 69%</th>
<th>&lt; 70%</th>
<th>Global analysis</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>73,47%</td>
<td>62,50%</td>
<td>69,14%</td>
</tr>
</tbody>
</table>

Graphic 68. Companies with any EMS depending on if they are construction companies or not.

<table>
<thead>
<tr>
<th>Percentage</th>
<th>&gt; 69%</th>
<th>&lt; 70%</th>
<th>Global analysis</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>94,44%</td>
<td>90,00%</td>
<td>92,86%</td>
</tr>
</tbody>
</table>
6.6.4 Analysis

Throughout this study and in lots of questions it has been justified the difference in the percentages of Slovenia and the rest of the countries, as well as it has been commented on the fact that this difference was the result of the variation in size and typology of companies.

As examples of this we should point out to questions 6, 7, 11 and 12, which belong to part 3 of the present study devoted to the analysis of quality management systems (QMS). Three of these questions, numbers 6, 7 and 12 make reference to the adoption or not of these systems, and question number 11 describes the main reasons for establishing them.

In reference to the most important block of this study, that is part 4 corresponding to environmental management systems, we could apply to questions 15, 17, 18, 19, 22, 23, 25 and 26 as examples. Most of these questions are related to: the adoption of the different environmental policies and the EMS, the implementation of the ISO 14001 or the intention of establishing it in a near future, and finally the most important areas for the surveyed companies.

Firstly, we will focus on the size of the companies. If we analyse the first graphic we notice that in the case of Slovenia there is a majority of SMEs, a 63%, while in other countries this percentage decreases to 44%. This data is very important, as it is observed...
in the following graphics, since both in the case of QMS and the EMS more positive results for large companies are obtained.

In specific reference to the quality management systems, a 78% of the SMEs have at their disposal the ISO 9001, while this percentage increases to 94% for large companies, which proves that large companies have a more elevated percentage of implementation of the ISO 9001. It is easily observable that Slovenia and the rest of the countries have very similar percentages, since in the first case we speak of a percentage of 77% of SMEs and 94% of large companies, while in the rest of the countries these percentages are 19% and 94%, respectively.

With this we can assure that the difference between the results for Slovenia and the rest of the European countries is justified because the former has a wider percentage of small and medium-size companies. This makes that the total percentage descends, since if we separate and analyze the results according to the size of the company we notice that the results are identical for both cases.

In the case of the EMS we can observe this same tendency of results in which small and medium-size companies do always have lower percentages in the establishment of environmental policies, in the establishment of any kind if EMS and for the implementation of ISO 14001 [3, 27, 56, 58].

In the case of environmental policies, while in large companies almost 92% have already establish one, in the case of SMEs this percentage descends to 51%, a very significant difference. Then, in reference to the establishment of any kind of Ems once an environmental policy is established these percentages vary from the 100% of large companies to 73% of SMEs. Finally, in relation to the companies that have established the ISO 14001 percentages vary from the 88% of large companies to 57% of SMEs.

If we focus our attention on SMEs and large Slovenian and European companies we would observe that the results are very similar, proving then that there is no difference in the percentages of Europe and Slovenia. The percentage of Slovenia is lower in lots of the questions because the surveyed companies in this country are mainly small and medium-size companies 63%, while in the rest of the companies there is a majority of large companies of 56%.

Within any sector, small and medium enterprises represent a particularly important group due it their large number, total revenues and number of employees.

Different reports suggest that the outreach to this group should be different form the general approach in order to promote sustainability. The share of companies with an
EMS is higher for large companies, which further confirms that the outreach should be targeted more specifically towards the SMEs. Hence, we can conclude that it is important to be aware that the drivers, as well as the barriers for EMS implementation, are different for corporate companies and for the SMEs [3, 27, 56, 58].

The other phenomenon that can be observed and that distinguishes Slovenia from the rest of the countries is the percentage of construction companies that were surveyed for each case. While in Slovenia this percentage represents 64% of the companies, in the rest of the countries this percentage is elevated to the 73%.

As it was previously commented this difference occurs because in the case of Slovenia more questionnaires were sent, a total of 77, and lots of them to companies of the construction sector, though not all of them. Given the fact that it is a small country we do not have such a big reference of large companies either, so we decided to extend the study to more varied typologies of companies related to this sector, as those companies that produce materials as well as engineering companies. On the contrary in the rest of the countries an important majority of questionnaires were sent to large companies, though small and medium-size companies were also taken into account and sent questionnaires. This task was not easy for the rest of the countries, since only 10 to 15 questionnaires were sent per country, a reduced number in comparison to the total of companies that may work in a country.

This reference helps us to understand the difference between the percentages observed in the adoption of the EMS in the different countries together with the date obtained according to the size of the companies.

If we analyse graphics 67, 68 and 69 we can observe how construction companies have a higher percentage in reference to the establishment of the EMS, and it is specially the ISO 14001 the most common and adopted certificate among them. For construction companies this percentage increases to 75%, while for companies of other typologies it is of 50%.

This data justifies the difference that exists between Slovenia and the rest of the countries for most of the results that are obtained in the study. Some other aspects that may influence are the culture, the environment, the legislation, etc. of each particular country.

Finally we may conclude by pointing out to the fact that large construction companies of around Europe do generally establish any kind of QMS and EMS.
7 Conclusions

The main objective of the present study has been to analyze the implementation of the environmental management systems (EMS) in the construction sector. The investigation was carried out within European construction industry.

Environmental regulations are nowadays of growing importance, and in fact, one of the ways to put in practice the principles of sustainable development and to manifest the increasing environmental awareness at the company’s level points directly to the implementation of an environmental management system (EMS), being ISO 14001 the most widely established form.

Countries that have been object of this study including Croatia, which from the 1st July 2013 will take part of the EU, are all promoting these principles as members of the European Union, and therefore no surprise should arise that the general environmental awareness is growing.

With this purpose and in order to investigate whether the construction companies perceive different barriers in EMS implementation, 135 questionnaires were sent to construction companies of very varied countries such as: Austria, Croatia, Italy, Spain and more specially to Slovenia. In this last case we have also analyzed the evolution that has been taking place since the year 2006, when the PhD and external tutor Jana Šelih went through a similar study [56].

Then, the conclusions to which we have reached at the very end of this study are the followings:

Conclusions on the methodology:

1) The sample studied has been considered representative in the case of Slovenia because of the high number of questionnaires that were sent, with a total of 77, and received, and with a participation of 64%. In the specific case of the Julian Alps this sample is considered significant with a total of 121 sent questionnaires and a percentage of participation of 63%. Finally, we should highlight the fact that this study is considered indicative in terms of the results obtained for the European Union, with a total of 135 sent questionnaires and a participation of 60%.

From this participation we can conclude by saying that the system that was chosen for the development of this investigation, the web survey, has been a
good solution since, if we compare the actual participation of Slovenia to that of year 2006 we observe that it was 17% less.

2) The obtained results show reasonably high environmental awareness of responding companies. One could argue that companies holding the ISO 9001/14001 certificates are more likely to take part in the survey. Even so, the percentage of answered questionnaires has been high, which gives us an insight into the quality and environmental management trends in the European Union. Of the total of answered questionnaires it is easily observable a very high percentage of abstention in open questions, which makes us conclude by referring to this kind of question as a non functional one. The percentage of final participation was of 60% thanks to previous work that was done before sending the questionnaires, and which consisted not only on contacting with the responsible of the environmental area of the company, but also on ensuring the anonymity of firms.

Hence, we could observe a major participation of the SMEs according to the communication we have maintained with these companies, which has been much easier and fluid. On the contrary, contacting the responsible person of large companies seems to be more difficult, and consequently their participation in this study has been less.

Conclusions on the content:

1) Construction firms are realizing that environmental management is a primary key to their success. They understand that it is imperative to eliminate or minimize harmful environmental impacts from construction. In addition to this, the survey results show that a large proportion of responding companies (70%) has established an environmental policy, which is a first step in environmental management. The environmental issues all these companies are focusing on most are waste control, energy savings, recycling of materials and air/water pollution reduction. Handling of all these issues is most likely triggered by the changing legal regulations in respective fields. 46% of the respondents participating in the survey have an ISO 14001 compliant EMS, and 19% have a non-standardized EMS. Finally, 68 % of the respondents’ claim that they will start to implement the ISO 14001-compliant EMS in the near future.

From this investigation we can draw that the customer demand remains an important stimulus for the implementation of the ISO 14001.
2) A construction firm’s size and it typology limits its ability to establish an EMS. Small and medium-size companies have a lower percentage of implementation of environmental management systems. On the one hand, among the companies that have already established any type of environmental policy the percentage of establishment of any type of EMS is 83%, of which 57% have preferred the adoption of ISO 14001. On the other hand, in the case of large companies that have adopted an environmental policy the percentage of establishment of any kind of EMS has been 100%, of which 73% have opted for the ISO 14001. Different reports suggest that the outreach to the group of SMEs companies should be different and sector-specific form the general approach to promote sustainability [3, 27, 56, 58]. The share of companies with an EMS is higher for large companies, which further confirms that the outreach should be targeted more specifically towards the SMEs. This phenomenon does equally happen depending on the typology of the company. That is, construction companies, once they have adopted an environmental policy, result in a 94% of establishment of an EMS, of which 75% decided to adopt the ISO 14001. Then, in non-construction companies these percentages represent the 90% and 50%, respectively.

3) ISO 14001 allows construction firms to determine what EMS level is right for their organization, so they can maintain the balance between costs and benefits. A measure of a construction firm’s environmental impact, whether it is based on number of sites, number of employees, total profits, or number of environmental requirements per site, should help a construction firm to determine how to implement an EMS and if pursuing the ISO 14001 certification is worthwhile [7].

For construction companies, implementation of EMS should take into the account the unique features of the construction industry, such as unique product (that is, building) and production process, temporary production site, and a large number of participants who often belong to different legal entities. At times these types of certifications are so general that the ambiguity in their basis does not provide flexibility, but it generates bewilderment. Consequently, EMS programs should be developed and implemented with defined goals and commitments, since the ISO 14001 does not state specific environmental performance criteria or metrics to achieve [7].
4) When the systems comply to the ISO 9001 and 14001 standards, it is easier to establish the EMS if the QMS is already in place. It is also important to note that all the responding companies that hold the ISO 14001 certificate are also in possession of the ISO 9001 certificate. This is a practical proof that is easier to implement the EMS if the QMS is already established. Therefore, the survey conducted referred also to quality management and QMS. 84% of the respondents claim that they are faced by the clients’ requirements to have the ISO 9001 certificate. As this is the same proportion as the percentage of companies holding the certificate, it can easily be derived that the role of the client is vital in motivating the companies to implement the QMS. Combining this conclusion with the fact that companies having the ISO 9001-compliant QMS are better equipped to start implementing an ISO 14001-compliant EMS, we can conclude that promoting ISO 9001 within industry could also be the first step in promoting the ISO 14001 standard, and that the role of the client is crucial in the EMS implementation, as well [56].

5) Additional complex documentation associated with the EMS implementation is seen one of the largest barriers. This barrier could be overcome if the approach used in the incentives provided by the government and other agencies included sector-specific guidelines for EMS documentation. The most important perceived barrier has been the cost of the implementation of these systems. Objectively, although it is clear that investments on resources and time are inevitable to establish the EMS, it may not be true that these costs are excessive [56]. We can conclude by pointing out to the fact that the biggest problem for the implementation of an EMS comes from the procedure itself. In order to solve this the collaboration between the different government, professional bodies and training institutions has to be crucial for the success of the implementation of ISO 14000 EMS in the construction industry.

Another relevant barrier that can be observed in the present study is the one in relation to the subcontracting system. It is well known that in the construction sector this system is very much widespread in all important construction companies. Generally we can assure that the problem of application of good environmental practices by the subcontractors as well as the necessary training of workers is not adequately solved.
6) The analysis shows that clients and their requirements play a vital role that cannot be underestimated in spreading these systems in construction industry. The governments can take a lead to motivate the construction industry to comply with the regulatory requirements by making environmental performance a factor for consideration in tender evaluation and ongoing performance assessment [59]. The extent to which the different governments wish to restrict its choice of tenderer to those firms that have an environmental management system in place, will demonstrate its commitment to environmentally responsible operations. Since the government is a very dominant client, the environmental regulations will have an influence on the price that a customer pays. It is also likely that enterprises do not produce according to the market’s needs, but they produce to meet the governmental regulations.

7) Generally there are no relevant differences between the case of Slovenia and that of the rest surveyed countries. In fact, there seem to be some differences, but they end up not being real, since in Slovenia we observe a bigger percentage of small and medium size companies, 63%, and non construction companies, 64%. As it has been commented above, these two types of companies provoke the decline of the results of QMS and EMS. If taking into account the whole of the rest of the countries the percentage of small and medium- size companies is 44%, while for non construction companies the percentage is 27%.

8) In 2006 a total of 56 questionnaires were sent to different construction companies, of which 26 were fully answered, that is 47%, so in this study we have increased the percentage of answers to 64% [56]. In reference to the size of the companies there has not been any difference since 2006, when small and medium- size companies did also predominate with a percentage of 62%, a very similar percentage to the one observed in this study, of 63%. On the contrary, while in 2006 the percentage of construction Slovenian companies increased to 76%, in the present study we notice how this percentage has decreased to 63%. Then, in relation to the QMS in 2006 a percentage of 88% of the 26 surveyed companies that had already established a quality management system had preferred the ISO 9001 [56], a similar percentage to the actual one, which is of around 84%. It does also remain constant the result of companies that took advantage of a previous management system before establishing the ISO 9001, as well as the percentage of clients that do not require this certificate.
If we focus our attention on the EMS we should point out to the fact that in the previous study 14 of a total of 20 surveyed companies, a 70%, had already established any environmental management system, and that 6 of those which did not have it, a total of 4 had the intention of implementing it in a near future [56]. Then, in this study we show how a total of 90% of the companies have established any kind of EMS, of which 65% have chosen the ISO 14001.

Despite the difficulties that were found by the technicians in the process of implementation of the ISO 14001, we could conclude that the positive tendency observed in year 2006 continues to be constant and does even improve in year 2013.

Personally, this topic has aroused a great interest in me, since I did not know a lot on these certificates and the measures taken by companies to have a control over the environment. It is evident that the construction sector produces a big impact in our environment, and so it is our responsibility to keep track of all this and to apply a series of measures that may reduce as far as possible such impact.

Then, with the results that have been obtained in this study we should point out once more to the interest that this topic arouses in a world in which the environment impact has turned to be a topic of awareness and concern, according to its importance within society.
8 Bibliographical References


http://dikul.uni-lj.si/V?RN=98966995


Study on Environmental Management Systems in construction companies

Ambiente del Gobierno Vasco y Sociedad Pública de Gestión Ambiental, IHOBE. Online version:


[26] Institute for European Environmental Policy, 2013. Web: http://www.ieep.eu/


http://www.comercio.es/tmpDocsCanalPais/4DF42988E4C5B18AF08EE492B6D986E0.pdf


[57] Šelih, J. Environmental management systems in construction industry. University of Ljubljana, Faculty of Civil and Geodetic Engineering, Slovenia.


[61] Universiteit Leiden, 2013. Institute of Environmental Sciences (CML), Faculty of Science. Web: http://cml.leiden.edu/research/industrialecology/research/publications-ie.html


9 Annex I

9.1 ENGLISH QUESTIONNAIRE

9.2 SLOVENIAN QUESTIONNAIRE
10 Annex II

10.1 THE QUESTIONNAIRE USED IN 2006
11 Annex III

11.1 EXCEL USED