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## **IIW/EFW System for Professional Qualification and its impact in metalworking companies in Europe**

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Engenharia de Soldadura

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IIW/EFW System for Professional Qualification and its impact in metalworking companies in Europe

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**Resumo:** (menos de 300 palavras)

A tecnologia de soldadura é fundamental na indústria e requer profissionais altamente qualificados dada a concorrência de saberes que envolve e a exigência de qualidade que coloca.

A qualificação e certificação de pessoas é, assim, fundamental para o bom desempenho das empresas e a Federação Europeia de Soldadura desenvolveu um sistema implementado actualmente em 42 países em colaboração com o Instituto Internacional de Soldadura desde 1998.

O objectivo principal deste trabalho foi avaliar o impacto do Sistema EWF/IIW de Qualificação de Pessoas na área tecnológica de soldadura, nas empresas Europeias de metalomecânica.

Pretendeu-se com este documento apresentar um estudo que permita às empresas de metalomecânica Europeias entender a relevância em ter nos seus quadros de pessoal indivíduos que tenham as qualificações adequadas em termos de tecnologia de soldadura.

A metodologia de investigação utilizada baseou-se na realização de inquéritos às metalomecânicas, complementados pontualmente com a realização de entrevistas para esclarecimento de questões específicas. Foram recebidas 105 respostas provenientes de 14 países.

Do estudo efectuado foi possível concluir que existe uma clara mais valia para as empresas que contratam pessoal com qualificações profissionais emitidas no âmbito dos sistemas da Federação Europeia de Soldadura e do Instituto Internacional de Soldadura.

Todas as empresas que empregam pessoal com diplomas EWF/IIW fazem menção que obtiveram ganhos tanto intangíveis como tangíveis, com a existência de pessoal com diplomas EWF/IIW nos seus quadros;

Foi possível a partir deste estudo desenvolver um método de cálculo que permite determinar “o melhor” número de coordenadores de soldadura por empresa tendo em linha de conta o número de empregados da empresa que têm actividades ligadas à tecnologia de soldadura.

Do estudo, pode concluir-se que existe uma relação entre o rácio RD (número de pessoas qualificadas/dimensão da empresa) e a redução de Sucata ou a redução de Reparações ou o aumento da Produtividade.

Palavras Chave: Soldadura, Formação, Qualificação Profissional, Sistema EWF, Sistema IIW



**Abstract:**

Welding technology is fundamental in manufacturing and requires highly qualified professionals due to its multidisciplinary nature and the quality requirements that are needed.

Thus, qualification and certification of human resources is crucial for the good performance of companies. The European Welding Federation developed a qualification system that is in place in 42 countries in collaboration with the International Institute of Welding since 1998.

The main goal of the present study was to evaluate the impact of the EWF – European Welding Federation Training & Qualification System in the field of welding technology, on European metalworking companies.

This document aims to present a study that allows European companies to understand the relevance to employ staff who have appropriate qualifications in terms of welding technology.

The research methodology adopted was based on the use of an inquiry addressed to metalworking companies, complemented by dedicated visits to clarify specific issues. 105 answers were received from 14 countries.

From the developed study it was possible to conclude there is a clear advantage for the companies to hire qualified persons with EWF and/or IIW diplomas.

It is possible to draw from the study a calculation method to determine the “best” number of welding coordinators per company taking into account the number of persons engaged in welding, this gives a good idea about the possible ratio between number of WC and the number of company personnel engaged in welding.

All the companies that employ persons with EWF/IIW made the mention that they have obtained gains either in intangible benefits or in tangible benefits.

From the study, it can be concluded that there is a relation between the Ratio RD (Number of Qualified Persons/Company Size) and Scrap reduction or Repair reduction or Productivity increase.

Keywords: Welding, Training, Professional Qualification, EWF System, IIW System



## **Symbols, notes, and abbreviations**

ANB	Authorised National Body (National organisation approved by EWF and/or by IIW for the implementation of the EWF and/or IIW Training & Qualification system)
ANBCC	Authorised National Body for the Companies Certification (National organisation approved by EWF and/or by IIW for the implementation of the EWF and/or IIW System for Companies Certification)
ATB	Authorised Training Body (A training organisation approved by an ANB for the implementation and development of EWF and/or IIW training courses, under the EWF and /or IIW Training & Qualification System)
CEN	Centre Européenne de Normalisation
CPD	Construction Products Directive
EA	European Co-operation for Accreditation
ECCW	European Council for Co-operation in Welding
EWF	European Welding Federation for Joining and Cutting
DVS	Deutscher Verband für Schweißen und verwandte Verfahren e.V. (The German Welding Society)
IAB	International Authorisation Board (The IIW Board for the Management for the IIW Qualification & Certification Systems)
IIW	International Institute of Welding
ISO	International Standardisation Organisation
PCS	EWF or IIW Personnel Certification System
PED	Pressure Equipment Directive
TC/44	ISO Welding and Allied Processes Technical Committee
TC/121	CEN Welding Technical Committee
WC	Welding Coordinator(s)



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## **Chapter I**

### **INTRODUCTION**

#### ***1.1. OBJECTIVES***

The EWF and IIW are two of the largest international organizations where it can be found the highest levels of technological knowledge in the field of welding and related technology. For about thirty (30) years these two organizations have been developing guidance documents and mechanisms for exchange knowledge that allow to support the metalworking industry in terms of best practices to be used in construction [34]. All this effort ended with the creation of two training and qualification systems: one European and another International (both systems recognised mutually), in the field of welding technology. These systems are very comprehensive in terms of competence/skill levels and sufficiently detailed for each level of qualification, and are mutually recognized, these two systems were also developed to allow the lifelong training.

The aim of the present study was to evaluate the impact of the EWF system in the metalworking companies in Europe, and verify if the system brings added value to companies employing staff and workers that have the EWF training and qualification. A second objective was to know if the companies effectively obtained gains in terms of productivity and quality in welding construction to help defining future strategy for the metalworking companies.

#### ***1.2. THE NEED FOR WELDING PROFESSIONAL QUALIFICATION***

Welding is a special process which needs specific controls in order to achieve the required quality level. Such processes are recognised in the quality management systems standard, ISO 9001 [1], for their specificity.

To achieve the correct quality standard for the weldments, the metalworking companies must address several aspects including: health and safety, environment, productivity, competitiveness, contractual requirements, etc. To achieve this, it is important to implement either a quality management system, e.g. EN ISO 9001 and/or Welding quality requirements, e.g. EN ISO 3834 [2].

The implementation of one of the above mentioned “systems” is mandatory for any metalworking company that wants to succeed in the present global business world of manufacturing and trading. A key issue in a competitive global market is the qualification of human resources.

Welding is a multidisciplinary technological manufacturing process that involves knowledge from different disciplines concurring to achieve the proper quality level. There are not many metalworking companies with welders with the correct skill level for the intended production, so it is important companies employ professionals with the appropriate level of knowledge at all levels.

During manufacturing of weldments all manufacturing stages must be under control, and for this, one of the most important issues that must be solved by the companies is the personnel qualification level.

When metalworking companies have on their working force, personnel with the correct level of professional qualification in terms of welding technology there is a high probability that during manufacturing of products the typical welding, problems will not occur, meaning the company will gain

several benefits such as: higher productivity, less repairs and scrap, higher capability to solve weldability [3] problems.

Regarding the working force and their level of qualification this was addressed since almost the beginning of the use of welding as a manufacturing process, when the so called product codes (e.g. ASME – Boiler and Pressure Vessel Code [4], in place since 1914 and AWS D1.1 – Structural Welding code - Steel [5], since 1928), start to include on their requirements the need to “approve” the welders skills and the approval of the welding procedures, as a way to ensure the quality of the welds. In the years that followed, specifications and standards on welder approval and welding procedure qualifications emerged from a number of countries. These two types of “approvals” are still seen as the core of the weldments quality. However, nowadays they are insufficient to reach the quality levels required. Therefore, it was felt a need to develop additional “specifications” that would deal with some other job functions/activities related to welding quality.

In the 1960s and beyond, “specifications” dealing with the competence of non-destructive testing (NDT) personnel [6-8] and welding inspection personnel emerged [9-10].

In spite the above mentioned “specifications” have been developed, implemented and used by all players related with the welding manufacturing, at the present they are already insufficient. This is, due to the present quality level required by the markets, is not seen as just the fulfilment of the construction technical specifications defined on the product code or contract, but also flexibility, productivity and safety must be accomplished.

In a global market, quality also includes “to do it well at the first trial”. To achieve the new quality standards and also to fulfil the higher requirements that are imposed to product manufacturing (e.g. the EU Directives like the Pressure Equipment Directive - PED [11] and Construction Product Directive - CPD [12]), the metalworking companies must employ personnel with the appropriate professional qualification level, not only in terms of welders, NDT and welding inspection personnel, but also other staff engaged in welding, namely the Welding Coordinators according to EN ISO 14731 [13], previously known as EN 719 published in 1994. That is nowadays, if metalworking companies do not have on their staff qualified personnel, either they will have significant difficulties to fulfil the requirements that are mentioned on the UE Directives, or they will not be able to compete against the other companies that employ personnel with recognised professional welding qualifications.

Actually metalworking companies face major challenges, for instances, they must overcome the following aspects:

- i) Flexibility;
- ii) Productivity;
- iii) Safety of the product.

Flexibility emerge because metalworking companies should be able not only to produce more than one type of product either in large or in , and they must continuing seeking for new markets and/or clients.

Regarding productivity this can be addressed either minimising the amount of welding repairs and scrap and/or improving the amount of welding production in terms of welded meters per hour of working hour.

Safety of the product can be only achieved if the weldments are properly done, following a correct fabrication plan. If this is not ensured during the different production stages, from the design until the last manufacturing operation, the safety of the product will not be achieved.

Thus, it is clear that anyone who can have an impact on the final quality of a weldment must have the required knowledge/competence for his/her specific job task. It is like a chain - a 'welding quality chain' - if only one link is missing or faulty, the chain will break and several kind of problems can occur, namely the "quality" of the product.

The above issues can only be solved or improved if the company has staff able to understand the new challenges and to find new solutions, and this can be achieved if the staff has the appropriate level of knowledge/competence and skills.

That is why the welding coordination is at this moment a key factor for the improvement of the metalworking competitiveness. The correct implementation of the two standards, EN ISO 3834 and EN ISO 14731 are the key to the cost-effective manufacture safe and reliable welded products.

The knowledge/competence requirements in EN ISO 3834 and EN ISO 14731 are a major step forward in recognising the special importance of welding and in ensuring that welding production is under competent control.

So it is important for standards organization bodies to call up the standards in applications standards and for client organisations to specify these standards in their contracts.

As mentioned above the special importance of knowledge/competence in welding has been recognised for many years. Since the 1980s a great deal of effort has been put into the development of an internationally harmonised education, training, qualification and certification system [14].

The European Welding Federation - EWF [15] and the International Institute of Welding - IIW [16] are two majors welding organisations in which international expertise in welding and related technologies is assembled. EWF and IIW have worked together for the development of an unique and comprehensive training, qualification and certifications systems covering the most important job functions in the welding field. These systems are harmonised world-wide [17], and based in harmonised training guidelines and a quality assurance methodology [18]. These organisations have issued a wide range of training and qualification guidelines in addition to the existing ones that deal with the knowledge requirements for RWCs – Responsible Welding Coordinators. Adoption of these training guidelines, where relevant to the tasks required, can also facilitate the assessment of competence in more specialised welding and related areas. Further promotion of this is required.

The system is now mature and is implemented and widely recognised throughout the world. Some of these harmonised qualifications are also mentioned in ISO 3834 and ISO 14731. Over 140,000 diplomas have been awarded.

Innovation and harmonisation of training and qualification is a general issue and many other professions have been analysed, projects developed and methodologies proposed. Examples can be find in very different cases as a modernisation of training for the police foresee [19], to civil

engineering [20], or thermography technicians [21]. The EWF and IIW approach of harmonisation through networking and standardisation has also been used in other cases with good results [22].

The EWF Qualification System is a valuable tool for individuals seeking wide recognition of their knowledge and skills and for employers seeking to employ competent people. Qualification and Certification widely recognised inspire confidence in holders, in employers and in clients who purchase welded products. The harmonised system is largely focused on education and examination leading to the issue of a 'Diploma'. Meaning a professional Qualification.

EN ISO 14731 requires the manufacturing organisation to appoint at least one Responsible Welding Coordinator (RWC). It is useful that the standard makes reference to the International/European qualification system as a way of dealing with the technical knowledge requirements for RWCs.

Welding Coordination as described in ISO 14731 covers many different welding and welding related tasks covering the entire 'welding quality chain' mentioned above. This includes:

- Review of requirements; Technical review
- Sub-contracting
- Welding personnel
- Equipment; Production planning
- Qualification of welding procedures; Welding procedure specifications; Work instructions
- Materials; Welding consumables
- Inspection and testing before, during and after welding
- Post-weld heat treatment
- Non-conformance and corrective actions
- Calibration and validation of measuring, inspection and testing equipment
- Identification and traceability
- Quality records.

In order to comply with the standard, the manufacturer must be able to show that employees with any of the tasks listed in ISO 14731 must possess appropriate competence. EWF/IIW have developed a wide range of 'guidelines' that describe courses of training designed to underpin different welding related jobs. Therefore for many of the activities covered by welding coordination in EN ISO 14731, a harmonised and recognised International/European course is available. However, these courses are not widely used at present and, again, more must be done to convince industry of their value.

### ***1.3. MOTIVATION***

The processing industry in Europe represents about 30% of global gross domestic product [23]. From this, a significant portion is related to metal products, produced in Europe in companies that use welding (see Figure 1 for examples) as a major transformation process.



Fig. I.1: Welded Products Examples

The importance of welding technology in the global economy is assessed as being of paramount importance. In 2008, DVS Germany [24] conducted a detailed and comprehensive study regarding the economic impact of the welding technology. This study used estimations, collected statistical data and mathematical modeling and the results show that the total added value generated by the European industry, which is linked to welding technology, represents about 83 Billion Euros year and estimates that approximately two million people work with welding and allied technologies.

The security, reliability and improved cost/productivity of welded construction require that the manufacture has the appropriate quality. Welding is considered a special process that requires very specific controls, both for the welding process and for the welders and/or welding operators who use the welding process in order to obtain the desired quality level. Special processes, as recognized by the EN ISO 9001, require a specify approach within the quality system. Ignoring this particular special process condition and the need for specific controls can result in the worst situations to catastrophic failure (see examples of Figure 2A and 2B) with possible high losses of material goods and human. These more catastrophic cases are rare but not unknown [25 – 27].

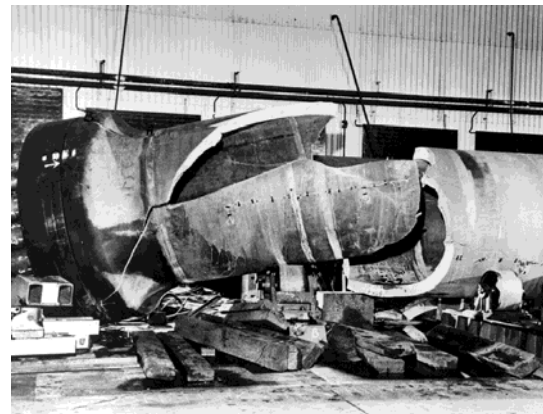


Fig. I.2A: Catastrophic Failures Examples

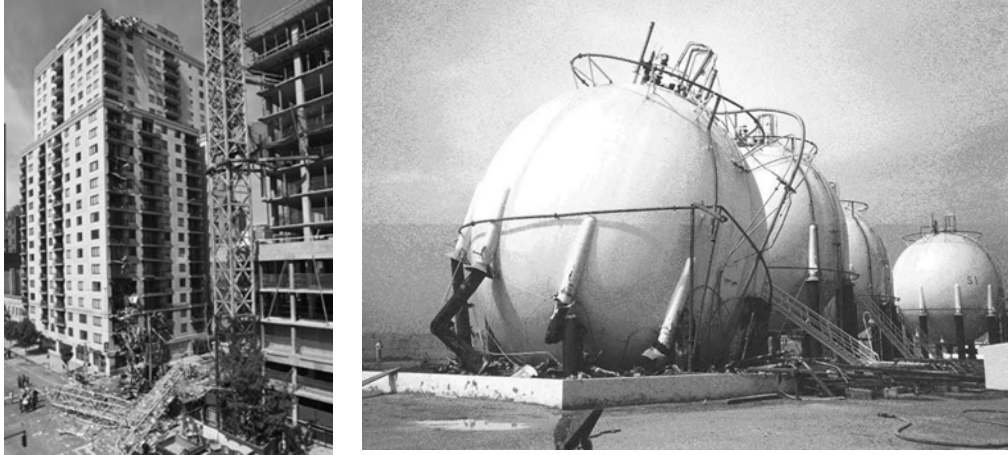


Fig. I.2B: Catastrophic Failures Examples

To overcome such problems improvements in the management of people and organizational structures are necessary; In other words through better utilization of human resources [28], also changing technology and structural trends in industry provide an opportunity to create more demanding, more flexible jobs and requiring forms of human resource management, integrated into European environments regulated by standards and healthy completion [28].

In the metalworking companies technical knowledge is mandatory in welding and often the work is developed in hard conditions and harsh environment. Employee relations are also of major relevance since, in most cases, professionals are working far from their homes and strongly dependent on each other [29].

Most metalworking companies have problems related to welding processes, lack of control, over costs during the manufacturing process and/or after sales, delays in product delivery, contractual problems, etc, which are usually originated due to the need for weld repair during manufacture and/or after been in use in post-sale. Costs due to repair are usually estimated to be about six times, the initial cost of welding [26].

The importance of welding technology was recognized very early. For example in 1918, the Technical Committee of Lloyd's Register of Shipping, report [27] the use of electric arc welding in shipbuilding, showing that its content in general is positive in terms of the introduction of welding in construction and performs a series of proposals aimed the regulating the use of welding, some of the recommendations were:

- *The Committee requires that operators use the process to undergo a specific training and must have experience and be able to use the welding system proposed for use.*
- *Supervisors must be sufficient and shall have expertise and capacity dully verified/approved. The relationship between the number of welders and supervisors must be defined and subject to approval.*

The above proposals and others were taken and it was edited as Lloyd's rules to be obeyed in shipbuilding.

So, the need of competence/expertise in welding is not a new issue. For many years the main bodies that verify or approve equipment's or products obtained by welded construction, have pointed out the need for people who are involved in "welding" to have the right expertise/skills.

Nowadays, the control of welding as a special process is achieved through the implementation of the standard EN ISO 3834 - Quality requirements for fusion welding (this standard was originally published by CEN as standard EN 729 in 1995). This standard defines specific requirements for the level of competence of staff that has responsibility for the activities associated with welding, such as welders, technicians, non-destructive testing personnel, welding inspectors and welding coordinators. This standard is relevant because it states the importance that all persons who may have an impact on final welded product quality must have the proper level of competence/skill for the function/task they perform.

The investment in employee training and development is well known to have benefits for the organization and for its work force [32].

The importance of the training and qualification system of EWF is to harmonize the training and qualification of the personnel mentioned above. This recognition is even reflected in the informative annex of EN ISO 14731 –Welding Coordinators, functions and responsibilities (this standard was originally published by CEN as EN 719 in 1994), where it is mentioned the EWF/IIW qualification levels for the Engineer, Technologist and Specialist (currently is referred to the international qualification system, the previous standard CEN mentioned the EWF qualification levels), as a way to evidence welding coordination capabilities.

In summary, the safety and profit in welded construction largely depend on the operations/activities, meaning that it will depend on technical control of welding operations [33]. The staff with direct impact on the quality of welded joints needs to have a level of knowledge/competence/skill appropriate to their job function/activity, as a way for companies to achieve a higher competitiveness and to be easier for companies to fulfill the market demands and requirements.

#### ***1.4. STRUCUTRE***

This thesis is divided in five chapters. Chapter I was developed as an introduction to the study describing the importance and the need for metalworking companies to employ qualified professionals on the welding technological field as a way to achieve higher competitiveness and to comply with the present requirements regarding the UE Directives. Chapter II presents the EWF System for the qualification of Personnel on the Field of Welding Technology, its organizational structure, the range of guidelines developed and the relevance of EWF Qualification in terms of reference on the EN and ISO standards and UE Directives. Chapter III presents the Methodology used in this study. Chapter IV focus on the analysis of the collected data and is subdivided in eight subchapters. Finally Chapter V presents major conclusions and suggestions for future work.



## Chapter II

# THE EWF SYSTEM FOR THE QUALIFICATION OF THE PERSONNEL ON THE FIELD OF WELDING TECHNOLOGY

The aim of this chapter it is to characterise EWF and the EWF system for training, qualification and certification of personnel and also referring the most important standards that makes the reference to this system

### **II.1. MAIN GOALS OF EWF**

The European Welding Federation it is an association created by the leading welding institutes and societies of the European countries. In each country there is one member, all members are EFTA or EU Countries. At the, present the EWF networks comprises twenty nine countries, from these two have applicant status and one is an observer (non-European country).

EWF was official created in 1992 with the following goals:

- Promote the welding activities and knowledge in Europe;
- Establish harmonised systems for training, education, examination qualification and certification of personnel in the welding field;
- Promote the employment of qualified persons in welding;
- Contribute for the removal of technical barriers;
- Establish relations with official EU and EFTA organisations regarding the standardization in the welding field;
- Promote the dissemination of technical and scientific information;
- Promote and gives support to members in EU projects;
- Organizes conferences and scientific-technical events in Europe in the welding field.

Currently, the Technical Committee has expertise in the :

- Preparation and definition of the Guidelines for Training & Certification of Persons and the Rules of Implementation, adopted by the members (ANBs);
- Definition of Rules and Procedures for Authorisation/Approval of ANBs;
- Preparation and definition of the Guidelines for the Certification of Companies in terms of quality, environment and health & safety and the Rules of Implementation, adopted by the members (ANBCCs);
- Definition of Rules and Procedures for Authorisation/Approval ANBCCs

The Technical Committee is divided in several sub-committees dealing with specific matters, regarding the development of training guidelines, rules and requirements to be applied within the EWF System, by the members.

## II.2. CURRENT SITUATION ON THE DEVELOPMENT OF THE EWF QUALIFICATION SYSTEM

For the training activities is now established a network of national bodies (ANB - Authorized National Bodies) authorised to implement the guidelines adopted by the General Assembly of the EWF for the training, evaluation, qualification and certification of personnel.

The main levels that EWF has implemented so far are [35]:

EWE - *European Welding Engineer*,

EWT - *European Welding Technologist*,

EWS - *European Welding Specialist*,

EWP - *European Welding Practitioner*,

EW - *European Welder* – For the following welding processes - TIG, MMA, MIG/MAG + FCAW and Oxigas), for each welding process there is three (3) levels (Fillet, Plate and Tube), [36];

EWIP - *European Welding Inspection Personnel* (three levels – Comprehensive, Standard and Basic), [37].

The flow chart below shows the interconnections between the EWF main training guidelines.

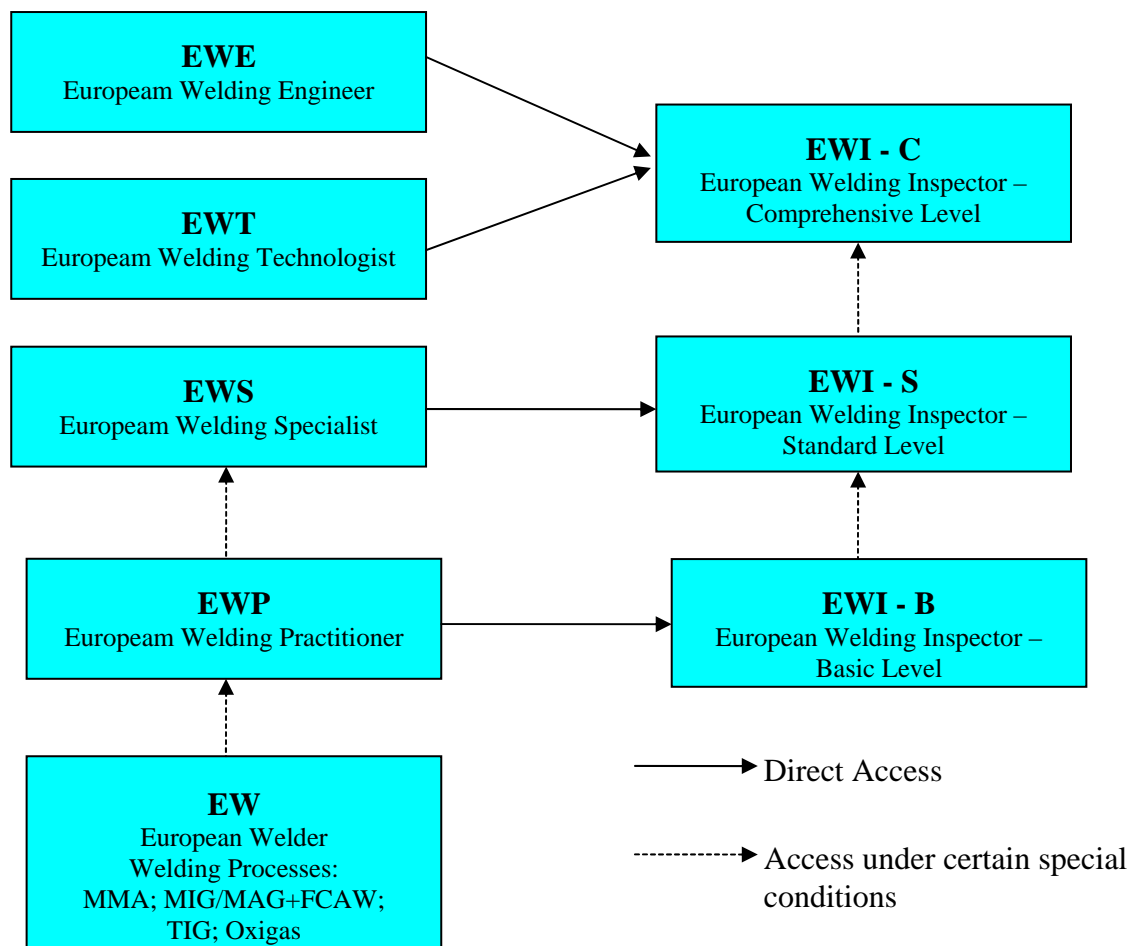


Fig. II.1: EWF Representation of the main Qualification Levels and Interconnections

All above mentioned qualification levels allow the issue of EWF qualification diplomas, recognized within both EWF and IIW networks and mentioned in ISO and CEN standards.

The qualification structure of EWF includes other levels of qualification and also the designated special courses. Competence recognised by taking these special courses leads to the award of Records of Achievement.

The main difference between the two types of courses is mainly the nonrestrictive access conditions and the simpler type of evaluation for the Special Courses. On annex 1 more detailed information can be seen.

The EWF has also developed guidelines that allow the certification of Persons (PCS) for the following levels: Engineer, Technologist, Specialist and Practitioner.

This Certification system is linked to the EWF Qualification System. The EWF PCS, is implemented on each country via the approval of an ANB.

The EWF has also created two independent systems for certification of welders and welding operators for metals and plastics, [38, 39].

In terms of the certification of companies (for the metalworking field), it was established a certification system [40] that enables integrated certification in the area of Quality (EN ISO 3834), Environment (EN ISO 14001, [41]) and Health & Safety (OSHA 18001 [42]). The last two systems only deal with welding and allied processes. This system is implemented by each country via the approval of an ANBCC – Authorised National Body for Companies Certification

### ***II.3. EWF AND ITS INSTITUTIONAL RELATION WITH IIW***

The European Federation for Welding, in 1995 at the request of the International Institute of Welding initiated contacts at the highest level with the IIW for the purpose to implement at international level the whole system of training and qualification already developed by EWF.

The IIW has recognized the important work undertaken by the EWF and since 2000, by adopting systems in terms of qualification & certification of persons and companies in welding. This created the possibility to implement an International system.

Presently the IIW has already implemented the quality system and also the main training guidelines, particularly for the levels of the Engineer, Technologist, Specialist, Practitioner, Welder and Inspectors. At the present it is possible to award diplomas with worldwide recognition, and the IIW diplomas are also recognised by EWF.

### ***II.4. EWF AND IIW AWARDED DIPLOMAS STATISTICS***

As it was mentioned before the EWF training and qualification is in place since 1992, and IIW training and qualification is in place since 1998. Both systems work together and the European ANBs are authorised to award the International diplomas.

The charts bellow shows the evolution of EWF and IIW awarded diplomas until the present [43], due to the mutual recognition some European Countries has decided to award only IIW Diplomas what explains the decreasing on the award of European Diplomas

From the charts below it can be seen that the EWF and IIW evolution of awarded Diplomas.

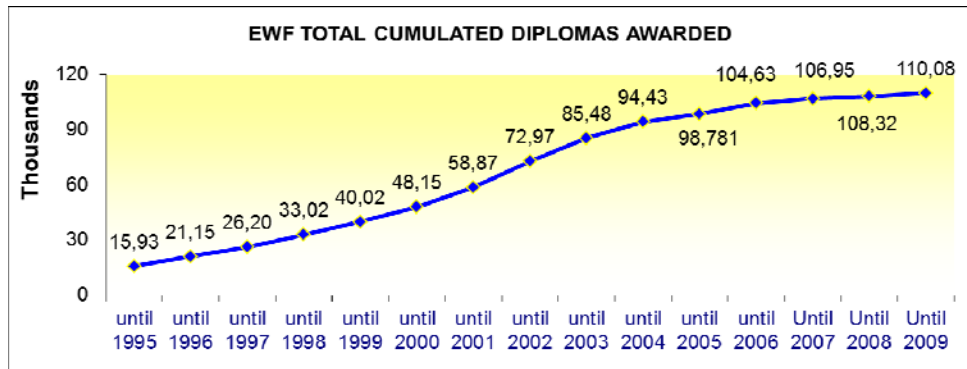


Fig. II.2: EWF Total Cumulated Diplomas Awarded for all EWF Guidelines and Special Courses

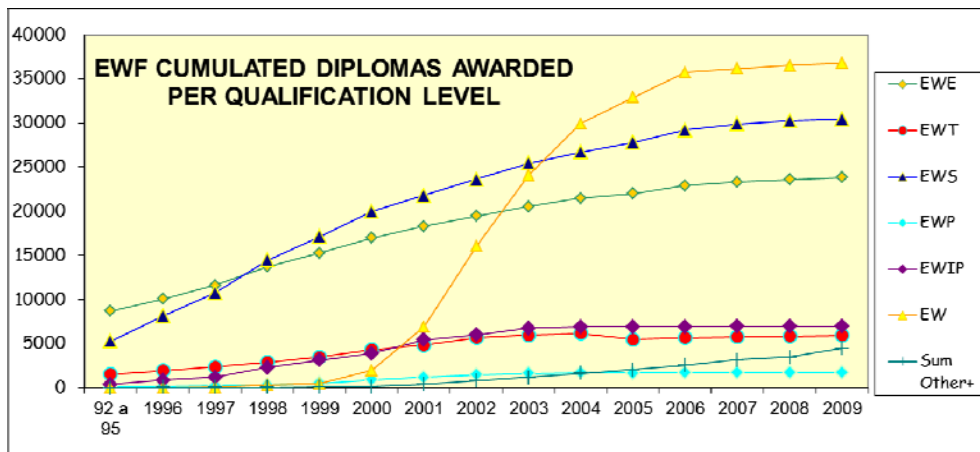


Fig. II.3: EWF Total Cumulated Awarded Diplomas per Qualification Level

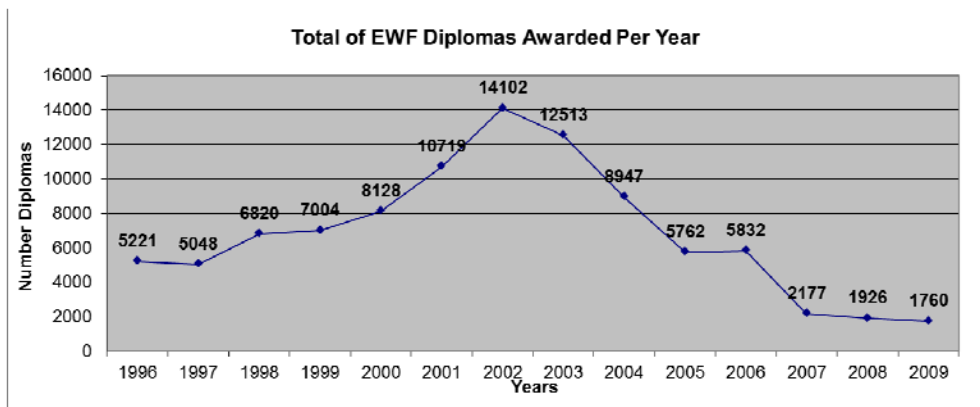


Fig. II.4: EWF Awarded Diplomas Per Year for all EWF Qualification Levels

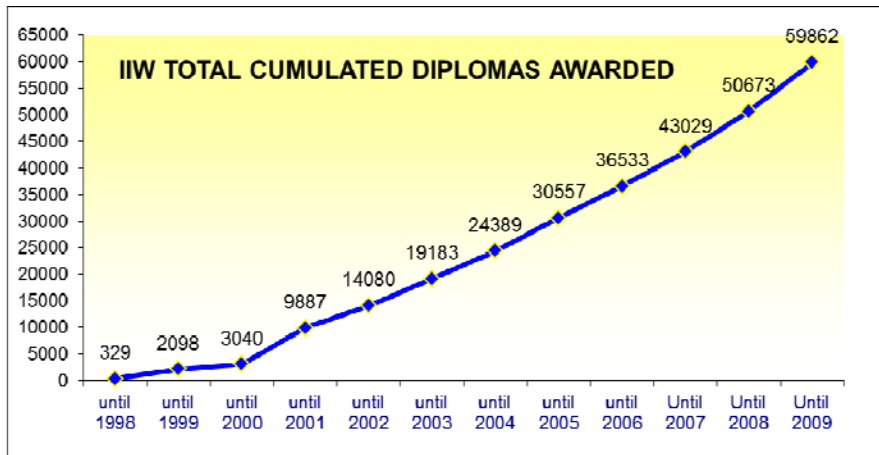


Fig. II.5: IIW Total Cumulated Diplomas Awarded for all IIW Qualification Levels

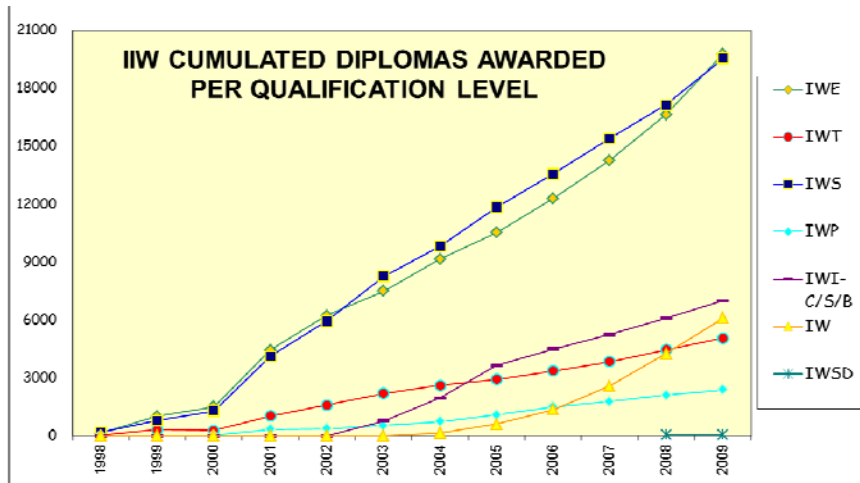


Fig. II.6: IIW Total Cumulated Awarded Diplomas per Qualification Level

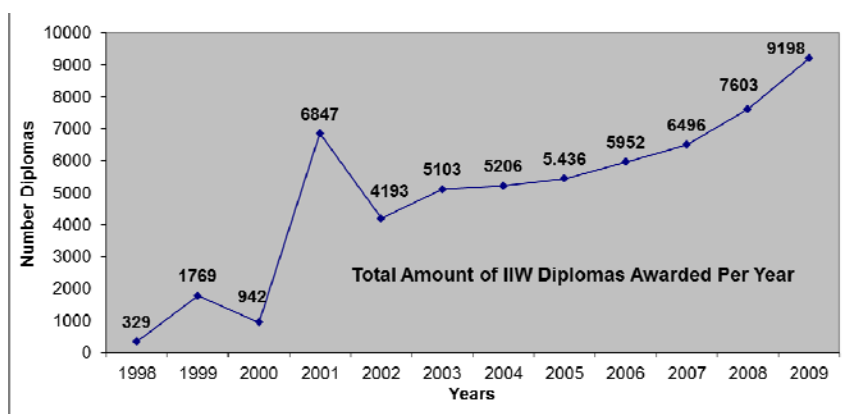


Fig. II.7: IIW Awarded Diplomas Per Year for all IIW Qualification Levels

## **II.5. THE EWF REFERENCES AT EN AND ISO STANDARDS AND EUROPEAN DIRECTIVES**

Welding is the most widely used technology to join metals and alloys efficiently and to add value to products.

The application of welding technology is strongly regulated by standards which are essential to assure quality reliability, flexibility, and scalability, and to streamline regulatory compliance.

European Welding Federation (EWF) is a welding organisation in which international expertise in welding and related technologies is assembled. For 20 years, this organisation has been tracking manufacturing industry needs and trends and developing guidance documents and technology exchange mechanisms to support companies seeking to adopt best practice and standards in welding. The industry needs to ensure that welds will have “zero defects,” and to establish practical methods to achieve that result. This is where EWF has a role to play since it creates the bridge necessary to facilitate reaching this goal through the development and support on implementation of guidelines that link standards with practice, in a simple way.

EWF has developed a comprehensive training, qualification and certification system, applied to both people and companies, harmonised on a world-wide basis. The system is based in harmonised training guidelines and a quality assurance methodology and has been developed in the frame of lifelong learning which is well recognised worldwide namely in EN and ISO standards.

## **II.6. THE EN AND ISO STANDARDS REFERRING TO EWF/IIW QUALIFICATION SYSTEM**

On this subchapter it is mentioned some of the EN and ISO standards that refers to EWF and/or IIW System. More detailed information is provided in annex 2.

### **Welding standards for general application:**

- i) EN ISO 14731:2006 - Welding coordination - Tasks and Responsibilities, on the informative Annex A, it is stated that the IIW Diplomas are a way to demonstrate the level of competence in welding technology. As a note, this standard of 2006 has superseded the EN 719:1994, the EN 719, on informative Annex A, mentions EWF qualification levels, because EWF Diplomas are equivalent to IIW, it can be stated that EWF Diplomas are still mentioned in an indirect way;
- ii) EN ISO 3834 series, namely the EN ISO 3834-5:2005 - Quality requirements for fusion welding of metallic materials - Part 5: Documents with which it is necessary to claim conformity with the quality requirements of ISO 3834-2, ISO 3834-3 or ISO 3834-4, on clause 2.3, table 2 – Welding Coordination Personnel, it is stated that for filling the clause 7.3 of EN ISO 3834-2, 3 and 4, EN ISO 14731, shall be applied, also on informative Annex A, once more the EWF/IIW qualification guidelines are mentioned as a way to demonstrate the level of competence in welding technology;

- iii) Technical Report, Document EN ISO/TR 3834-6:2007 - Quality requirements for fusion welding of metallic materials - Part 6: Guidelines on implementing ISO 3834, on sub clause 10.3.3, after table 4 - Correlation between ISO 3834 and ISO 1473 clearly mentions to the EWF/IIW qualification levels.
  
- iv) EN ISO 14554 series namely the EN ISO 14554-1:2000 - Quality requirements for welding - Resistance welding of metallic materials - Part 1: Comprehensive quality requirements, on clause 6.4, mentions that welding coordination shall be performed by persons who have demonstrated their competence according to the requirements defined on the EN 719:1994, including the specific mention to the EN 719:1994 informative Annex A, that is the annex that mentions the EWF Qualification levels. As note EN 719:1994 was superseded by EN ISO 14731 in 2006.

## **II.7. CONCLUSIONS**

The EWF and IIW Training and Qualification Systems are operating since 1992 and 1998, respectively.

From the information draw from the charts it can be seen these systems have been growing in what regards not only the number of qualifications, but also the number of awarded Diplomas till 2009 (the latest statistic information). More than forty two countries are implementing these qualification systems, from these twenty nine are European, a total cumulated of more than 110.000 European diplomas have been awarded since 1992 and more than 59.000 International diplomas have been awarded since 1998.

Despite the success the managers of the systems do not have a clear idea about the real benefit this international qualifications bring to the companies, and they cannot define a strategy to support industrial development.

The present study will contribute to clarify these aspects, using a survey answered by the metalworking companies, which is described in the following chapters.

The present study is more focused on the welding coordination level since this is one of the most important functions at the metalworking companies. The other qualifications, in spite of being also important do not have such an impact on the quality of the welded construction. Welders, welding inspection personnel, designers and other professional activities related with welding are important to achieve a good and sound weld, but the persons that are responsible to “think” the weld are one of the major keys to assure the quality of the weldments.

On the following chapters it will be seen that companies who employ qualified personnel have mentioned that they achieve gains in several types of tangible and intangible benefits.

The wide reference in standards and EU directives to the EWF/IIW qualification levels is an obvious indication of the relevance of these qualification and certification systems to the industry.

Compliance with welding standards is a relevant key for the metalworking companies' success in terms of achieving a high quality on their manufacturing. One of the aspects is to employ welding coordinators with appropriate qualification, like it is stated on some standards. It is, thus, important to assess if member of staff actually brings benefits to the performance of the company and to which extent his/her collaboration can make a difference in the company.

The survey in this study is aimed at contributing to clarify these aspects.

## **Chapter III**

### **METHODOLOGY**

The methodology used in this study was based on an inquiry designed to cover the specific objectives that was sent to the companies.

The survey was sent to all EWF members (29 European Countries), and answers were received from fourteen European countries. This was followed by phone interviews with companies in very specific situations.

The inquiry was developed with the aim to obtain the maximum information regarding the companies' characterization and if they employed or not professionals with EWF Qualifications. A significant part of the survey was dedicated to evaluate the benefits perceived by the companies employing EWF Qualified Personnel.

#### **The main goals of the survey can be summarised as follows:**

- 1)** To collect data regarding the implementation of the Training & Qualification (T&Q) System of the European Welding Federation (EWF) and/or the International Institute of Welding (IIW).
- 2)** To understand how the EWF and/or IIW T&Q Systems have affected the company business (if the company employs personnel with professional qualification).
- 3)** To understand what could be the main reasons for the companies not employing personnel with the professional Qualification from EWF/IIW T&Q System.
- 4)** To define strong and weak aspects of the training, qualification and certification system, through the companies perspective and use these to suggest strategies for the development of the EWF/IIW System worldwide.

#### **The survey structure was divided in six parts, they are:**

**Part A** (Page 1 - questions 1 to 10):

Company Description: This part aims to fully characterise the companies, including the industrial sector they fit in, the range of products manufactured, the cutting and welding processes in use, the shape/form of raw material and range of thickness and/or diameters. The goal of this characterisation is to have a global knowledge on the metalworking companies who answered the survey and also to verify if the survey can be seen as representative of metalworking companies.

**Part B** (Page 2 - questions 11 to 22):

Company personnel characterisation and qualification: This part envisaged to collect information regarding staff qualification background, namely personnel with EWF or IIW Qualification Diplomas as Welding Coordinators and/or others.

The goal of this part of the survey is to characterise the type of qualified personnel the companies has as employees, regarding the welding coordination job functions and responsibilities. This allowed understanding how companies address the issue of welding professional qualification aiming to ensure that the company has adequate staff to comply with the requirements of welding coordinator according to EN ISO 14731.

**Part C** (Page 3 - questions 23 to 40):

Benefits and Gains description and quantification: This part of the survey has the aim to obtain information regarding the relationship between company staff/workers with EWF and/or IIW T&Q professional qualification and company operating efficiency. The intention was to understand if companies obtained benefits and gains when employing EWF/IIW Qualified personnel. The companies who quantified some of the gains allowed to attempt to formulate possible relations between the ratio of Qualified Persons and total company employees and the benefits/gains that have been quantified. This part of the survey was just answered by Companies who marked personnel with EWF or IIW Qualification Diplomas.

**Parts D and E** (Page 4 and 5 - questions 41 to 50):

Information why companies do not have on their staff EWF/IIW Qualification employees: This part of the survey aimed to gather information about the reasons why the company has not hired persons with EWF or IIW Diplomas. This information is useful to understand why these companies consider EWF/IIW qualified personnel could be or not useful and if they are planning to hire these levels of professionals.

**Part F** (Page 5 – question 51):

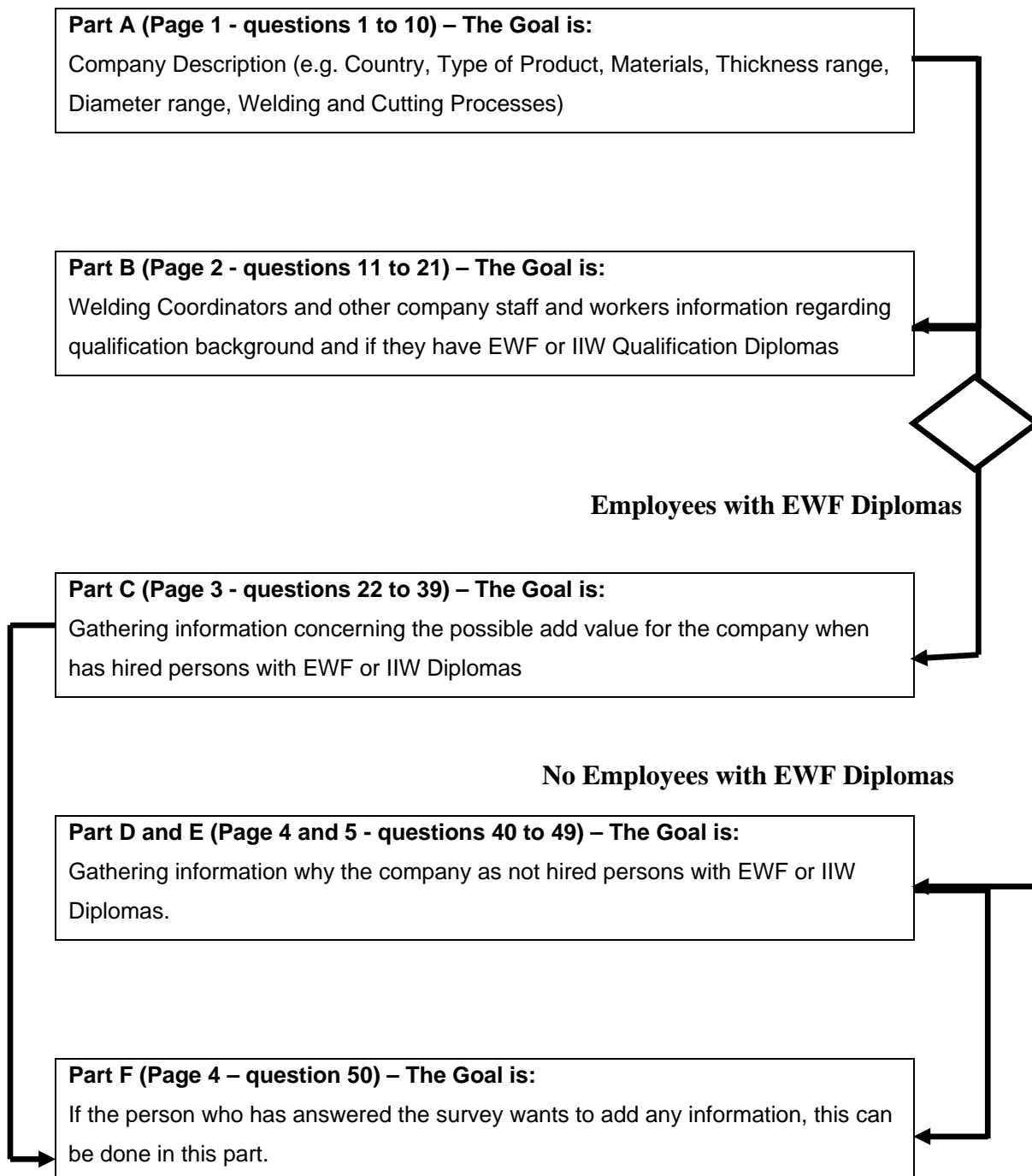
This is an open section to give the possibility to the persons answering the survey to include other relevant information.

The survey has some questions that were inserted with the aim to validate other important questions and to check the consistence of the answers. As examples:

- 1) Question A.4.1 gives information about the types of certification, when this question is crossed with question B.1, formal appointment of welding coordinators. The values obtained showed that the answers are coherent, since the percentage of certified companies with for formal appointment systems for welding coordinators is similar to the % of positive answers in question B.1.
- 2) Question C1.3 gives information if company has a higher understanding of welding technical problems. When this questions is crossed with the questions C.2.4 (better control of the

manufacturing phases) and C.2.5 (an easier identification of weak points in manufacturing process), the values obtained are very similar.

A flow chart of the survey is presented below.



Parts A and B, were to be answered by all companies with the aim to characterise the company, and provide information about the welding coordination staff and if the company had employees with EWF/IIW Qualifications. Some of the data from these two parts was used to develop possible relations regarding welding coordinators number and size of the company.

Part C, was to be answered only by companies who have employees with EWF/IIW Qualifications. This part was developed in a way that it was possible to gather information regarding the types of

qualification and the number of qualified persons. This was also used to obtain information on the company view regarding the effect of hiring qualified persons in tangible and intangible earnings. With these two parts it was possible to study the real benefits companies achieve with the EWF/IIW Qualification System and also developing possible relations between the number of qualified persons and possible benefits.

Part D and E, were to be answered only by companies who had no employees with EWF/IIW Qualifications. This part aimed to obtain information regarding the reasons why the companies have no EWF/IIW Qualified persons. With this information, EWF may be able to adjust its system to fulfil the requirements of a larger group of companies.

Part E has the goal to obtain further information that the persons answering the survey consider relevant to be mentioned.

The full survey is presented in annex 3

The survey was disseminated using two different ways:

- i) All the EWF ANBs Chief Executives received an e-mail explaining the goal of the survey, and some of them translated the surveys for their mother language and distributed among their country companies;
- ii) An internet tool was used to put the survey online protected by a password, in order to guarantee confidentiality and that just the target people could answer the survey.

For more details regarding the on line survey see annex 4

## Chapter IV

### PROCESSING SURVEYS DATA

The questionnaire was distributed using the network contacts of the author. This means sending to all forty two (42) Chief Executives of ANBs (Authorised National Bodies – Organisations approved by EWF and IIW to implement the EWF/IIW Qualification System). From the information received from the ANBs Chief Executives, the ANBs Chief Executives have distributed approximately 350 surveys, from which 1005 were received and only 101 were used.

Fourteen (14) ANB Chief Executives developed all the necessary steps to gather answered questionnaires. Below it can be seen the detailed information (Table IV.1.).

#### IV.1. Summary of Survey Answers

The circulation of the questionnaire generated a quite good level of answers which are summarised in the table and figures below.

In this sub chapter the results are presented while its analysis and discussion are done on the following sub chapters.

The answers received are summarized on the table and chart below.

Country	Number of Useful Surveys	Total number	Not Useful
Belgium	6	7	1
Bulgaria	7	8	1
Czech Rep.	5	5	0
Finland	1	1	0
Hungary	9	10	1
Italy	1	1	0
Netherlands	4	4	0
Poland	2	2	0
Portugal	21	22	1
Romania	17	17	0
Slovakia	4	4	0
Spain	11	11	0
Thailand	1	1	0
UK	12	12	0
<b>Total</b>	<b>101</b>	<b>105</b>	<b>4</b>

Table IV.1: Summary of Survey Answers

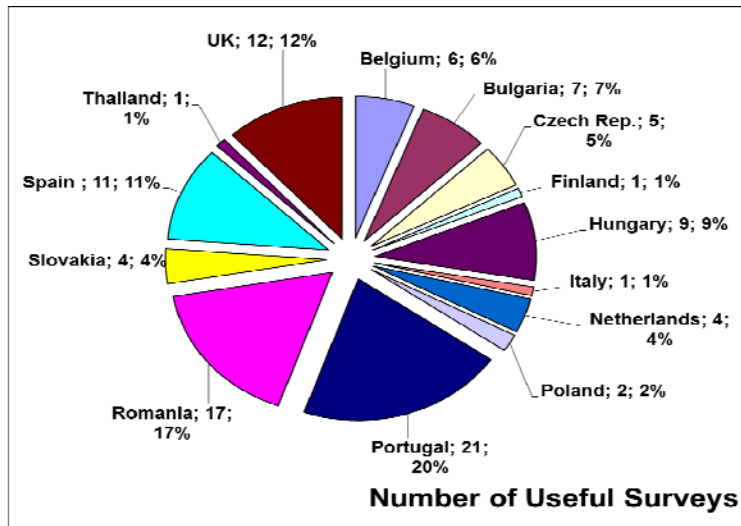


Fig. IV.1: Relation of Countries and number of Surveys Answered

For this study it was important to characterize the companies' staff and working force engaged directly in welding, for the discussion and analysis of the data, namely to obtain possible correlations between the company number of engaged personnel in welding and the company number of EWF/IIW Qualified personnel and number of welding Coordinators.

The majority of the metalworking companies that have answered the survey are small and medium size companies, in terms of the number of employees engaged directly in welding (Fig. IV.2.).

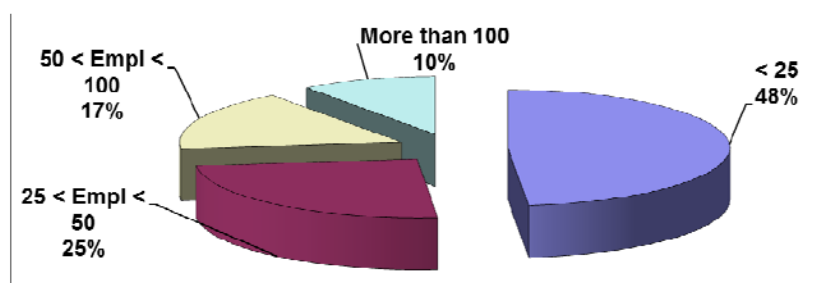


Fig. IV.2: Distribution of welding personnel amount on the companies sample

Another important aspect was to understand who had answered the survey, since for the specificity of this survey it is important to have the maximum confidence on the answers to the questionnaire.

On the figure below it can be seen that almost the totality of the answers were performed by persons who are qualified staff personnel, and their job functions are directly connected with the company welding activities i.e.: Welding Coordinators, Head of QA/QC Department and Production Manager.

A possible concern was the number of answers made by "other job functions", but the analysis of the other job functions, shows that the majority (almost 2/3) of the answers are persons who are related with welding activities, i.e.: Welding Instructor, R&D in Welding, Project Manager, Technical Director, Assistant Welding Coordinators, Welding Inspector.

From the Figure IV.3 it can be seen that answers are consistent with the company welding reality, therefore they have been used in this study.

Only a few number of answers (four in total) were not used, because they are incoherent.

The job function of the persons who have answered the surveys is depicted in Fig. IV.3.

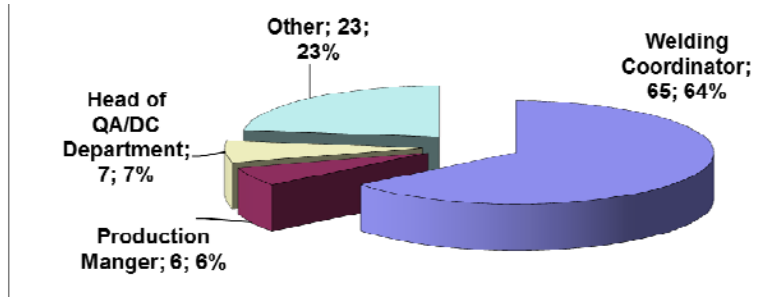


Fig. IV.3: Job Function of Persons who answered the survey

## IV.2. CHARACTERIZATION OF METALWORKING INDUSTRY

### IV.2.1 Company Characterisation

Regarding companies certification, the data collected shows that almost all the companies are certified at least by ISO 9001 and also the majority has more than two certifications. The share of EN ISO 3834 it is quite good, since this standard is not mandatory and is not yet recognised as an important standard for “quality in welding” (Fig. IV.4, 5 and 6).

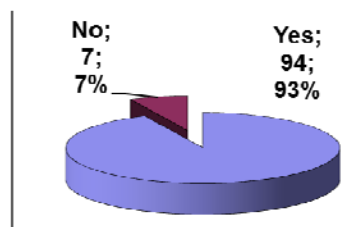


Fig. IV.4: Companies Certification distribution

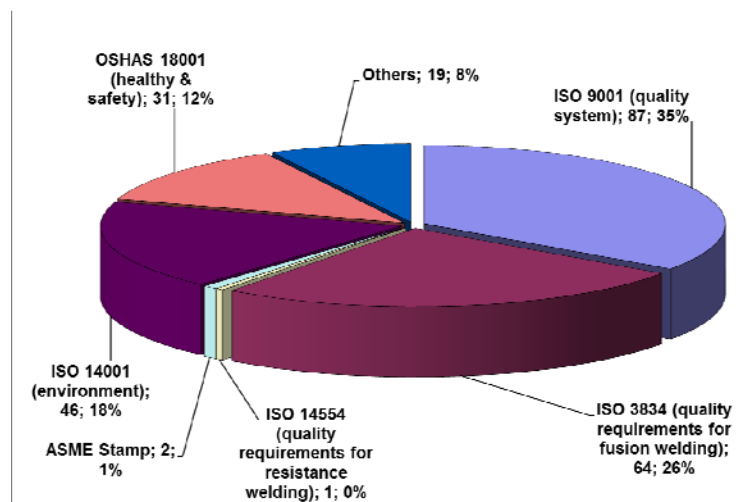


Fig. IV.5: Types of Certifications

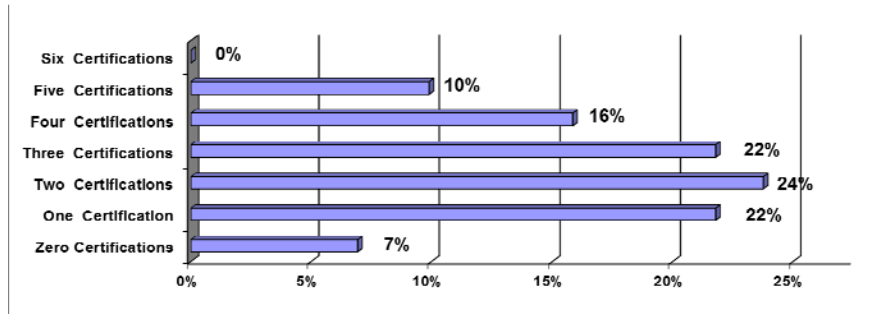


Fig. IV.6: Number of Certifications per Company

The characterization of the companies was also done in what regards the type of products manufactures.

The following charts provide information on company sector, raw materials used, form/shape of the raw materials, range of thickness and diameters and welding processes.

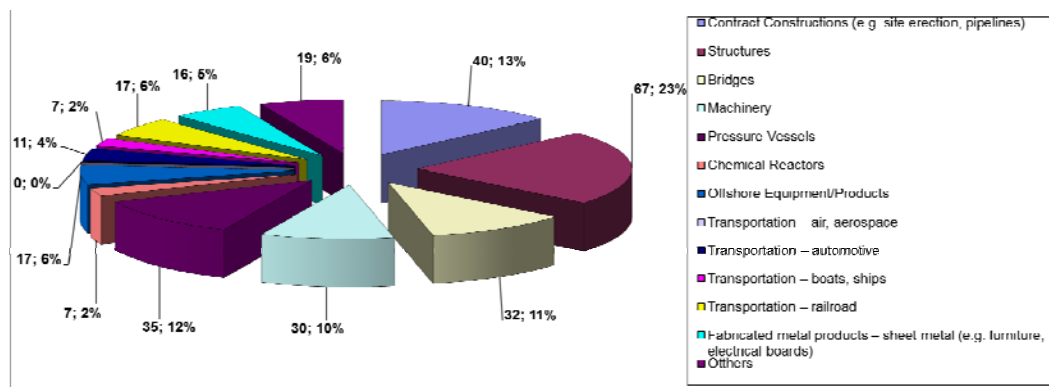


Fig. IV.7: Type of Activity/Products

It can be stated that 68% of the type of products are related with:

- Contract Constructions (13%);
- Structures (23%);
- Bridges (11%);
- Machinery (10%);
- Pressure Vessels (12%).

From these products Structures and Pressure Vessels represent almost 50%

This survey has also shown that the majority of the companies produce more than one type of product, as it can be seen on the figure below.

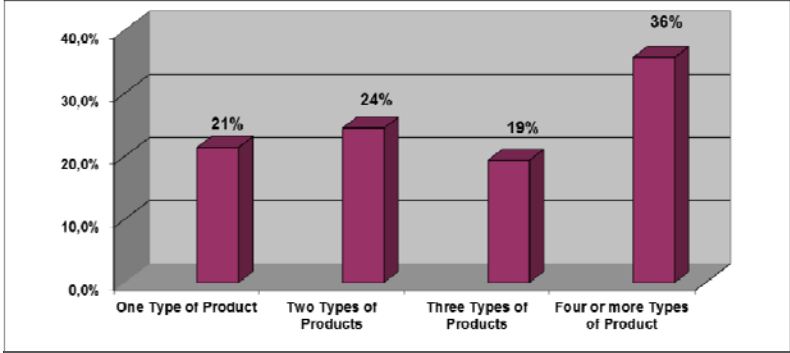


Fig. IV.8: Number of Type of Products per Company

In terms of raw material, as expected, steels including stainless steels represent more than 2/3 of the base materials used for the production (Fig. IV.9).

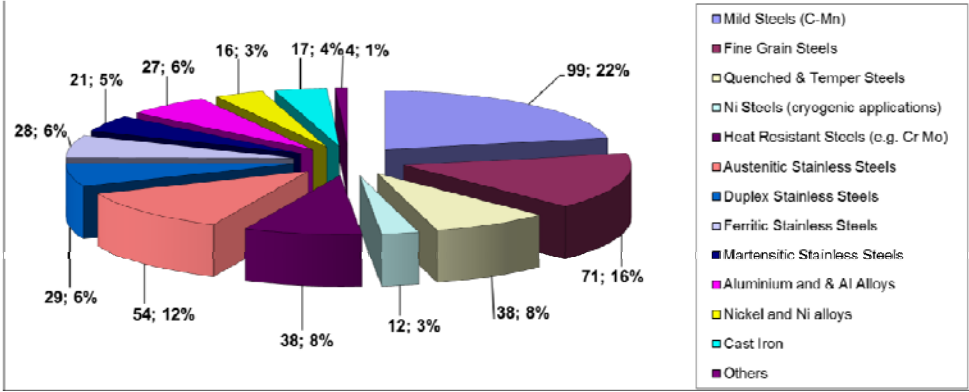


Fig. IV.9: Base Materials used by the Companies

Further details on type of product and the base material, thickness and diameter can be seen in annex 5.

In terms of raw materials, shapes, thickness and diameters is not possible to define a trend. The data is more or less equally divided between the several groups, as it can be seen on the charts below. Only the group of low thickness and diameter are less used, as expected.

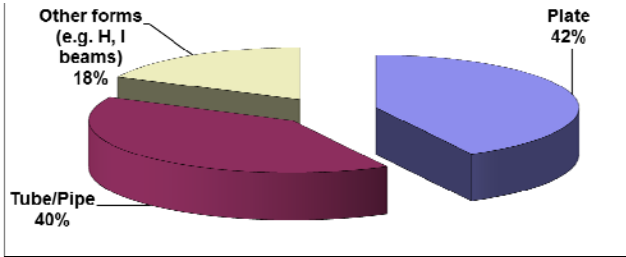


Fig. IV.10: Base Materials shape distribution

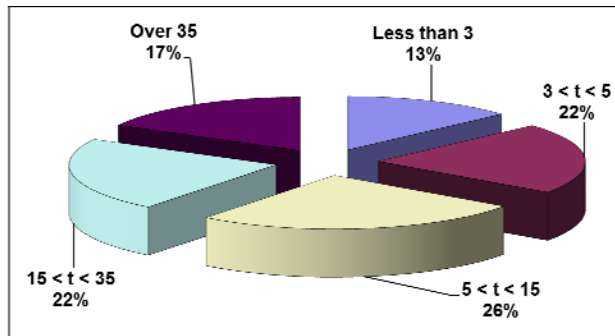


Fig. IV.11: Base Materials thickness distribution

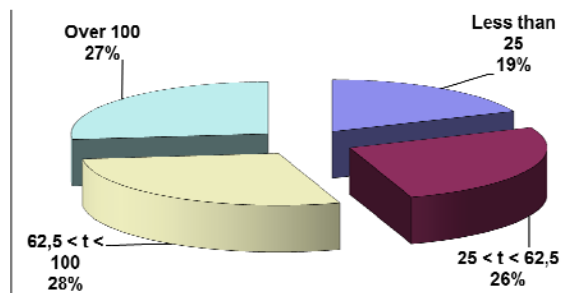


Fig. IV.12: Base Materials diameters distribution

In terms of welding processes, MMA, MAG and FCAW (assuming the different types of consumables as a unique process) are the mostly used by the manufactures.

On the second group, welding processes are: TIG, FCAW (Basic and Rutile), MIG and SAW.

An interesting result is the amount of companies who have marked the use of FCAW – Metal Core which is almost the same percentage of companies who have marked FCAW Self shield. This can be explained based on the information that on the last years the consumables manufactures have developed new types of FCAW Self Shied wires that can be used in any type of FCAW power source, and the majority of these wires can be used on steel structures.

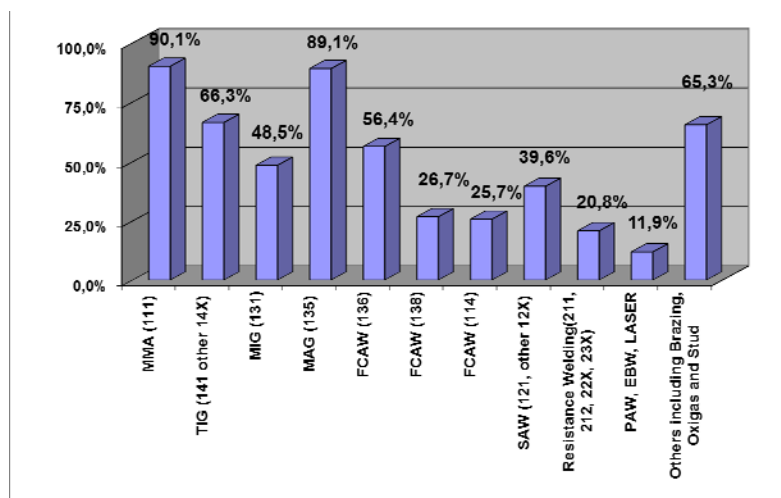


Fig. IV.13: Welding Processes percentage distribution

The two charts bellow regard cutting and gouging. From the analysis of the answers it can be stated that the percentage gathered confirms the typical distribution of the regular cutting and gouging processes.

Flame and Plasma cutting are dominant processes, with Flame cutting a bit ahead of Plasma cutting. The other two processes have lower percentages, due to the type of application. The Arc Cutting has not the same cut quality and productivity as the Flame or Plasma and it is only used in specific applications. In the case of LASER, this is namely due to the range of thicknesses that can be cut, that is quite small when compared to Flame and Plasma.

Arc gouging is the most important gouging processes and is much more used when compared to the other two processes, because this process has a higher productivity, and is easier to implement. The other two gouging processes, either the Flame or Plasma, are much more difficult to implement namely due to the operating techniques, difficulties in obtaining a stable “cut”, but also because these two processes are quite difficult to tune.

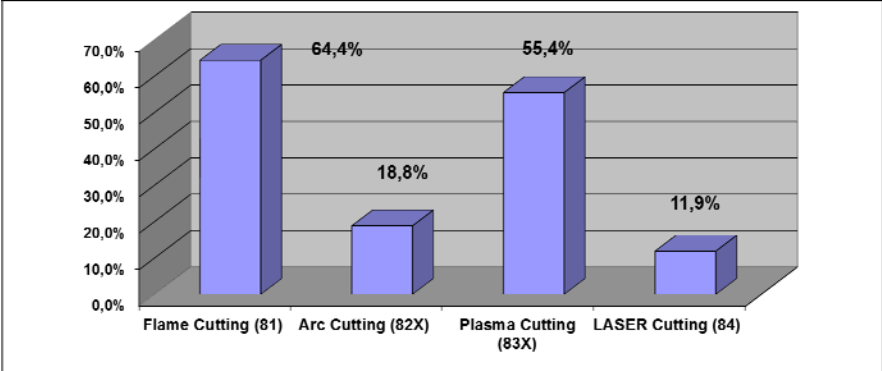


Fig. IV.14: Cutting Processes distribution

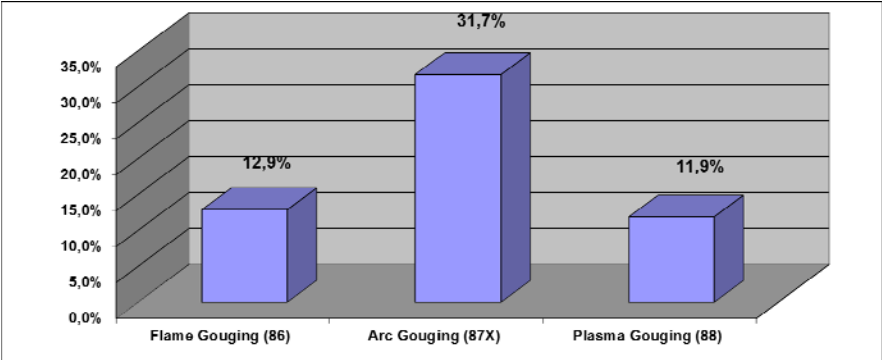


Fig. IV.15: Gouging Processes distribution

### IV.3. CHARACTERIZATION OF WELDING COORDINATION

#### IV.3.1 Welding Coordinators Characterisation

A Welding Coordinator according to the EN ISO 14731, has a significant role on the metalworking companies, their main responsibilities and tasks, they can be summarized as follows:

- Review of contract requirements and technical review;
- Definition of needs for Sub-contracting and requirements that subcontracts must fulfil;
- Definition of needs for welding personnel and supervision;
- Definition of needs for equipment and maintenance;
- Definition of production planning;
- Definition and supervision of qualification of welding procedures; welding procedure specifications and work instructions; and welder approvals
- Quality characterisation and control of raw materials and welding consumables;
- Definition and/or implementation of a Inspection and Testing Plan (before, during and after welding);
- Definition and/or control of Post-weld heat treatment;
- Definition, control and implementation of non-conformance and corrective actions;
- Definition and/or control of needed calibration and/or validation of measuring, inspection and testing equipment;
- Definition, implementation and control of identification and traceability of the welded joints;
- Definition, and/or implementation, control of quality records.

The EN ISO 3834, indicates that companies who want to comply with part 2 or 3 must appoint formally, at least, one Responsible Welding Coordinator, and on the EN ISO 14731, on the informative annex A, it is mentioned that the EWF qualification (for certain levels) his way to demonstrate the welding technical knowledge.

From the companies sample (101), almost 80% of companies has appointed formally the welding coordinator(s).

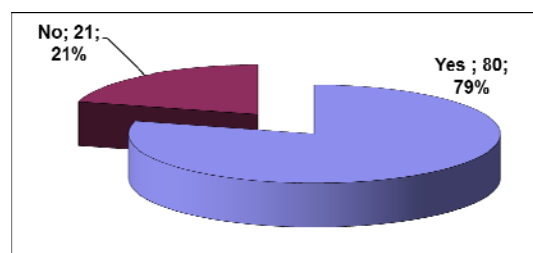


Fig. IV.16: Welder Coordinators Appointed by Companies

The distribution of the number of welding coordinators per company is:

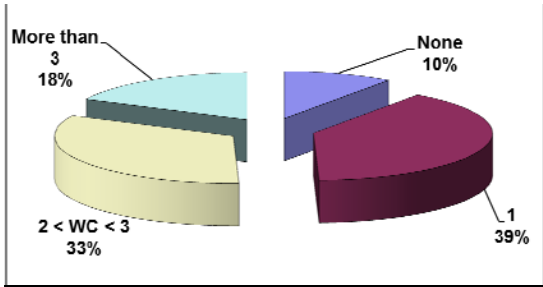


Fig. IV.17: Number of Welder Coordinators per Company

Using the data from Figure IV.2: Distribution of welding personnel on the companies', it is possible to create a relation with the data from the above figure. This relation will be discussed in the next sub-chapter.

**IV.3.2 Relation Between the Amount of Welding Coordinators and the Number of Employees per Company engaged in welding**

	%	N. Comp	WC
Values for Companies < 25 Employees			
Non WC	12,2%	6	0
WC 1	59,2%	29	1
2 < WC < 3	26,5%	13	2,5
More than 3	2,0%	1	3,5
Mean weight Value of WC for < 25 Employees for 49 Companies		49	1,33
Mean weight Value of the sample	0,250		
Variance Value of the sample for Comp.< 25 Emp.	0,047		
Standard Deviation Value of the sample for Comp.< 25 Emp.	0,216		

Table IV 2: Data regarding the companies with less 25 Employees engaged in welding activity

Key:  
 N. Companies – Number of companies for each range (n)  
 WC – Welding Coordinator - weight for each range (WC)  
 % - Percentage of answers for each range (a)

Statistics equations used:

Value for each WC range to be used on the Relation Between Company Size (employers) and the Amount of WC	$X_i = (a_i \times WC_i)$
Sample Value for each WC range	$X_i = a_i$
Mean weight Value either for sample regarding WC range or for the Relation Between Company Size (employers) and the Amount of WC	$\bar{X} = \frac{1}{N} \times \sum_{i=1}^N X_i$
Variance of the sample regarding WC or for the Relation Between Company Size (employers) and the Amount of WC	$S^2 = \frac{1}{N} \times \sum_{i=1}^N (X_i - \bar{X})^2$
Standard Deviation of the sample regarding WC or for the Relation Between Company Size (employers) and the Amount of WC	$S_{X_i} = \sqrt{\frac{1}{N} \times \sum_{i=1}^N (X_i - \bar{X})^2}$

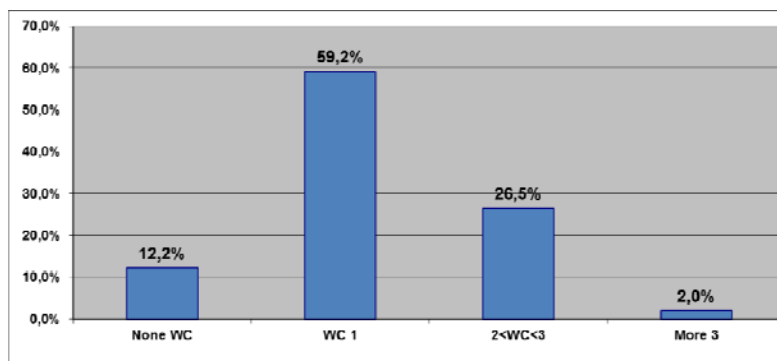


Fig. IV.18: Distribution of WC for Companies with less 25 employees

From the above information, the collected values show that for small companies 1 WC is normally enough for dealing with the welding activities, the need for 2 or even 3 WC can be explained due to the type of products and raw material used in manufacturing. The data regarding 0 WC shall be seen in two possible ways: due to the lack of knowledge from the company to appoint a WC or the company has an informal WC that has never been formally appointed.

	N.	
Values for Companies 25 < Empl. < 50	%	Comp
Non WC	4,0%	1
WC 1	28,0%	7
2<WC<3	48,0%	12
More 3	20,0%	5
Mean weight Value of WC for Companies with 25 < Empl. < 50	2,18	25
Mean weight Value of the sample	0,250	
Variance Value of the sample for Comp. with 25 < Empl < 50	0,025	
Standard Deviation Value of the sample for Comp. with 25 < Empl < 50	0,158	

Table IV.3: Data regarding the companies with Employees between 25 and 50 engaged in welding activity

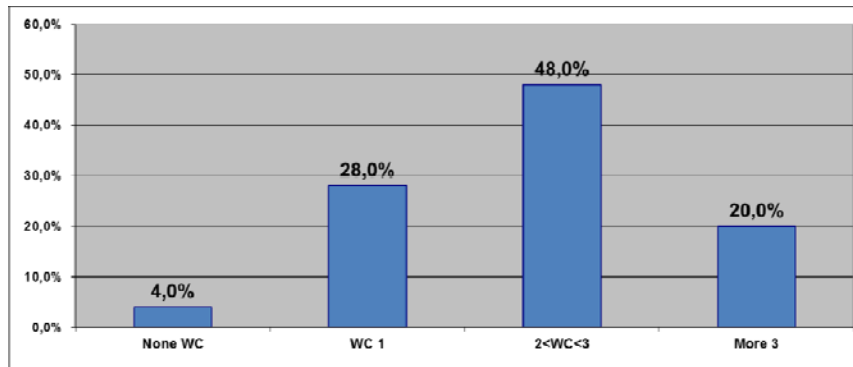


Fig. IV.19: Distribution of WC for Companies with employees between 25 and 50

From the above information, the collected values show that for small and medium size companies, 2 or 3 WC is the most mentioned according to the survey sample to deal with the welding activities. It shall be also pointed out that almost 1/3 of the companies are working with only 1 WC, this can be explained by the type of products and also may be due to the lack of information regarding the role of a welding coordinator.

	N.	
Values for Companies 50 < Empl. < 100	%	Comp
Non WC	5,9%	1
WC 1	17,6%	3
2<WC<3	29,4%	5
More 3	47,1%	8
Mean weight Value of WC for 50 <Empl< 100 for 17 Companies	2,56	17
Mean weight Value of the sample	0,250	
Variance Value of the sample for Comp. with 50 < Empl. < 100	0,023	
Standard Deviation Value of the sample for Comp. with 50 < Empl. < 100	0,152	

Table IV.4: Data regarding the companies with Employees between 50 and 100 engaged in welding activity

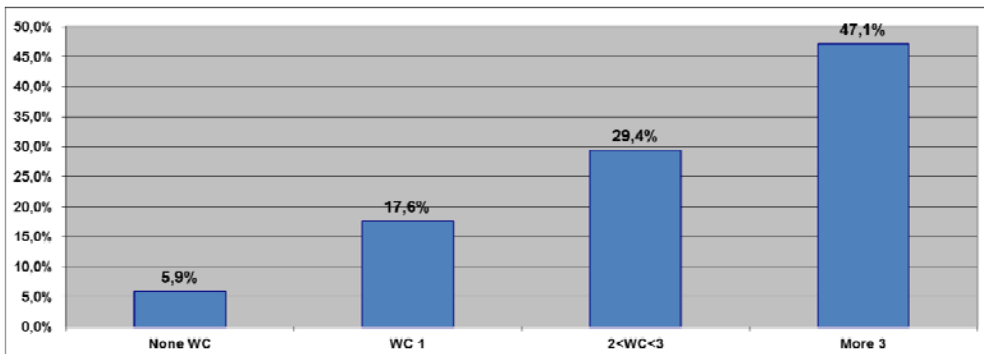


Fig. IV.20: Distribution of WC for Companies with employees between 50 and 100

From the above information, the collected values show that big size companies have often the need to have at least 3 WC. It can be also seen that almost 1/3 of companies have between 2 to 3 WC.

	N.	
Values for Companies Over 100	%	Comp
Non WC	20,0%	2
WC 1	10,0%	1
2<WC<3	30,0%	3
More 3	40,0%	4
Mean weight Value of WC for Over 100 for 10 Companies	2,25	10
Mean weight Value of the sample	0,250	
Variance Value of the sample for Comp. over 100	0,013	
Standard Deviation Value of the sample for Comp. over 100	0,112	

Table IV.5: Data regarding the companies with Employees over 100 engaged in welding activity

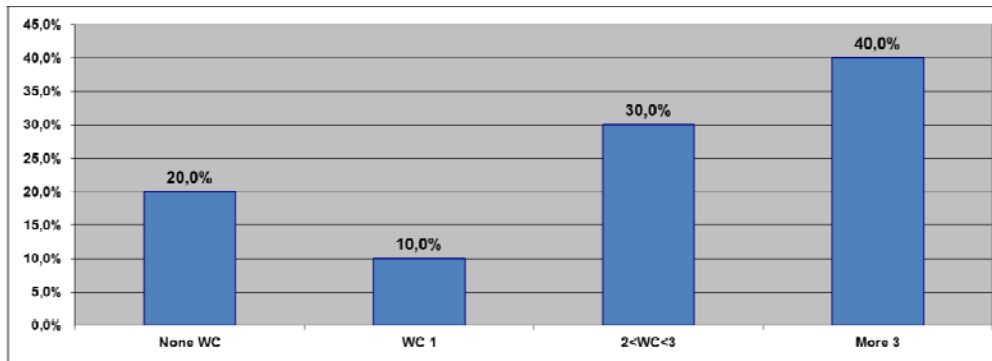


Fig. IV.21: Distribution of WC for Companies with employees over 100

From the above information, the collected values show that larger size companies often have at least 3 WC. It can be also seen almost 1/3 of companies have between 2 to 3 WC. The high value of the 0 WC in Figure IV.21 is a result of the sample dimension. This % value for 0 WC, originates a lower WC mean value that is not in line with the mean value of the companies with between 50 and 100 employees.

#### **Data regarding the relation of number of welding coordinator(s) and the number of employees engaged in a company in welding activities**

This data was developed with the aim to obtain a possible relation between the number of employees and the necessary number of Welding Coordinators.

From the above charts, it is possible to determine the WC average value for each company size sample, on each company size sample the mean WC was determined using the following methodology:

- 1) Defining a weight for each range of WC

Range of WC	weight
None WC	0
WC 1	1
2<WC<3	2,5
More 3	3,5

- 2) On each range it is known the number of companies (n), as an example for companies < 25 Employees, we have:

Range of WC	Number of Companies
None WC	6
WC 1	29
2<WC<3	13
More 3	1

- 3) For each range the number of companies was multiplied by the WC weight, as an example for companies < 25 employees WC between 2<WC<3, we have:  $n_i \times WC_i = 32,50$  (13x2,5)

- 4) For each company size sample, all the values obtained (like the example of item 3) were added and divided by the total number of companies of that sample, the value that was obtained it is the mean WC for each company size sample, as example for companies < 25 the mean value for WC is: 1,33

Relation Between Company Size (Employers) and the Amount of WC	Mean Value
< 25	1,33
25 < Empl. < 50	2,18
50 < Empl. < 100	2,56
Over 100	2,25
Mean weight Value for the sample relation	2,079
Variance Value for the sample relation	0,209
Standard Deviation Value for the sample relation	0,457

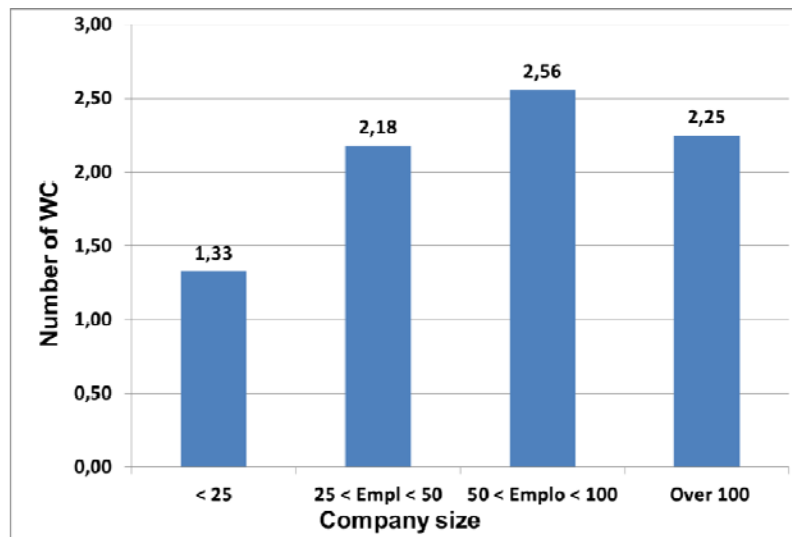


Fig. IV.22: Relation between Company Size (Employees) and Number of Welding Coordinators - WC

From the above data regarding the relation between the number of WC and the number of employees engaged in welding, it can be stated that:

- i) The general trend is according to the common sense, it means the bigger the company the more WC are necessary, and this is correct until a certain value;
- ii) The values obtained for companies over 100 employees, are not in line with all the other values. This result can be due to the dimension of the sample which is the smallest one. The WC mean value is lower than the WC mean value for companies that employ between 50 and 100 persons and it is almost of the same magnitude as for companies employing between 25 and 50 persons;

According to the author knowledge, the values shown on the above chart seem to be close to real ones in industry if it is assumed that:

- i) The term welding coordinator is regarded as the Responsible Welding Coordinator and to the Assistant or Deputy Welding Coordinator, and is not related with the definition of a welding coordinator according to EN ISO 14731;
- ii) For large size companies, above 100 employees directly engaged in welding, normally there is a well-structured organization, that normally do not need more than two or three welding coordinators (see item above);
- iii) The plotted values for large size companies on the above chart, should be “equal” to the value of medium “size” companies. The lower values obtained can be explained because the number of replies obtained in this category was the smallest one, thus the results need consolidation.

#### **IV.4. INFORMATION ON EWF/IIW DIPLOMAS AND STAFF**

The questionnaire aimed also at quantifying the IIW/EWF qualifications per type of company. This data is important since it allows evaluating the impact of that employing qualified personnel, with the required skills, can have in production.

From the answers survey (101 companies), displayed on the figure below it can be seen that the majority of companies are aware about the EWF/IIW Qualification system.

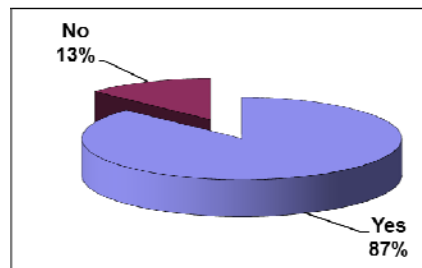


Fig. IV.23: Companies Knowledge regarding EWF Qualification System

Only 20% of the companies that answered the survey do not employ staff with EWF/IIW Qualification Diploma.

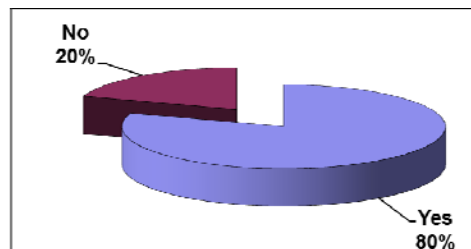


Fig. IV.24: Companies Employees with EWF Diplomas

The distribution of persons with EWF/IIW diplomas on the companies is the following one.

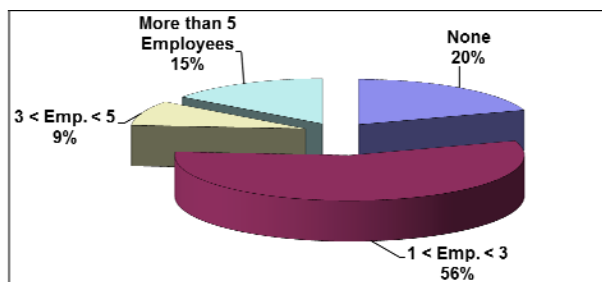


Fig. IV.25: Distribution of Employees with EWF Diplomas

For each more relevant welding activity, companies were asked about the type of education or training that the employers have, this information can be seen on the following charts:

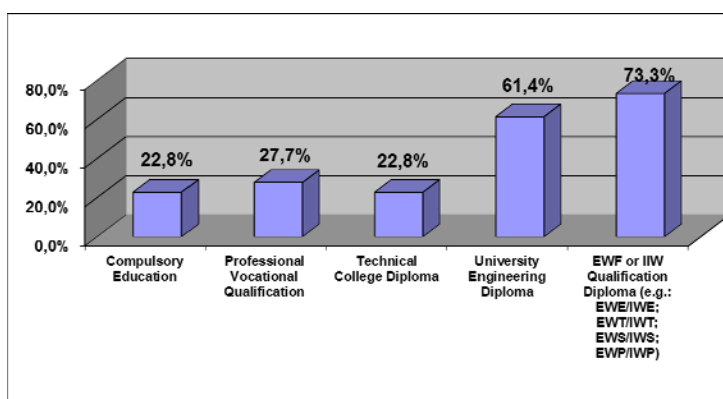


Fig. IV.26: Welding Coordinators Type of Education/Qualification

Regarding the Welding Coordinators it can be seen that the majority of the companies who have answered the survey employs staff with EWF/IIW Qualifications, and the education background is for the majority of the WCs an Engineering University Diploma.

Regarding welders, it shows that the EWF/IIW Qualification System is not yet so important as for WCs, and Professional Vocational qualification is still the most important. One of the possible reasons for this is that in the majority of the European Countries the EWF/IIW Welders Qualification system has not been adopted as part of the National Professional Vocational System.

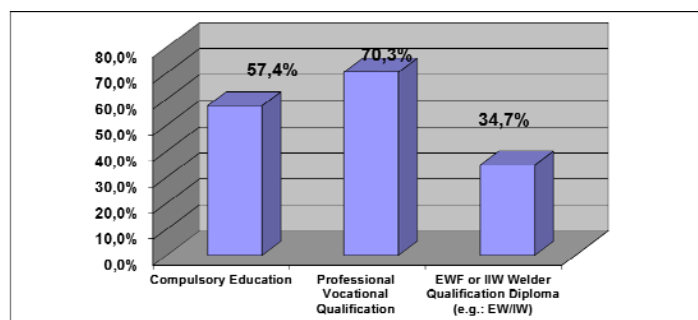


Fig. IV.27: Companies Welders Type of Training/Qualification

For the personnel engaged in welding Quality Assurance or Quality Control, the EWF/IIW Qualification for welding inspection personnel has, at the present, a lower level of implementation. Several reasons can be pointed out:

- i) Part of this personnel develops activities in the NDT field, and the EWF/IIW qualification system has no qualification on this field. Normally this personnel has a certification according to EN 473 or ISO 9712 or ASNT-SNT-TC-1. This is due to mandatory regulations regarding the NDT personnel;
- ii) In Europe there are some national certification schemes for the welding inspection personnel, and for some costumers the welding inspectors must have this national certification;
- iii) Typically, in Europe, the function of welding inspector is developed by NDT people, and the welding inspection is not recognized as an independent function from the NDT field (as it should be).

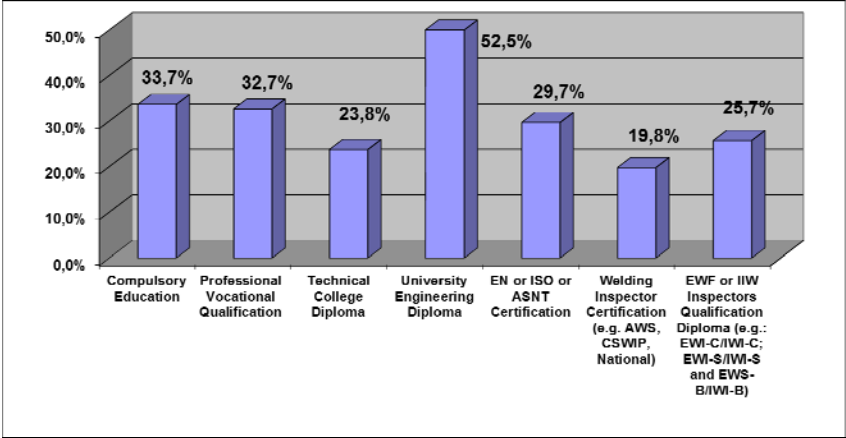


Fig. IV.28: Companies QA/QC Personnel Type of Training/Qualification

The percentage of diplomas in what regards Designers Qualification is very low, this is because this guideline is quite new. It was approved in 2006.

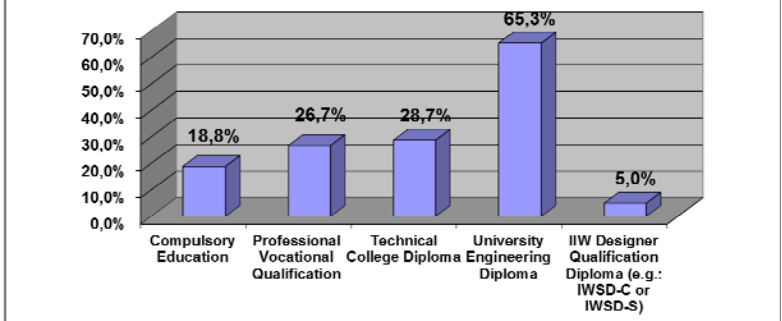


Fig. IV.29: Companies Designers Type of Education/Qualification

#### IV.5. DISTRIBUTION OF EWF/IIW QUALIFIED PERSONNEL EMPLOYED BY THE COMPANIES

##### IV.5.1. REGARDING THE COMPANIES SIZE

All the data below was gathered from the eighty one (81) companies survey answers that have mentioned they employ EWF/IIW Qualified Personnel.

The distribution structure of the amount of employees with EWF/IIW qualification and the distribution structure of type of Diplomas do not change so much when comparing between the several companies size samples. Therefore, on this sub chapter it will be just presented the charts regarding the companies with less than 25 employees and companies with over 100 employees. All the other charts can be seen on annex 6.

Analysis is given at the end of the charts below.

Values for Companies < 25 Employees	%	Number of Companies	Employees Weigth Value
None	24,5%	12	0
1 < Emp. < 3	59,2%	29	2
3 < Emp. < 5	4,1%	2	4
More than 5 Employees	12,2%	6	5
Mean weight Value of Diploma's for 25 < Employees for 49 Companies	1,96	49	
Mean weight Value of the sample	0,250		
Variance Value of the sample for Comp. with < 25 Employees	0,044		
Standard Deviation Value of the sample for Comp. with < 25 Empl.	0,210		

Table IV.6: Data regarding companies with less than 25 Employees (engaged in welding activity)

Key:

Number of companies for each range (n)

Employees Weigth for each range (EW)

% - Percentage of answers for each range (a)

Statistics equations used:

Value for each Number of Employees range to be used on the Relation Between Number of EWF/IIW Employees and Company Size (employees)	$\bar{X}_i = \frac{\sum f_i \times EW_i}{n}$
Sample Value for each WC range	$\bar{X}_i = af$
Variation, Standard Deviation to be applied on the above values	See subchapter IV.3.2

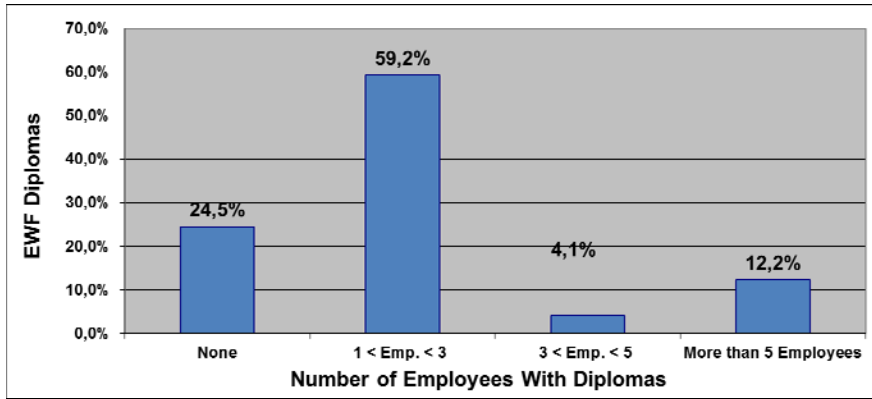


Fig. IV.30: Distribution of the Amount of EWF/IIW Diplomas in Companies less 25 Persons engaged in Welding

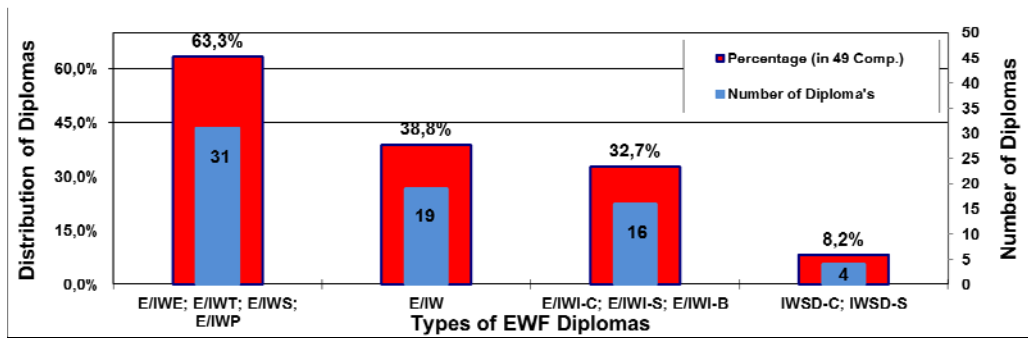


Fig. IV.31: EWF/IIW Types of Diplomas Distribution in Companies less 25 Persons engaged in Welding

Values for Companies 25 < Empl. < 50	%	Number of Companies	Employees Weigh Value
None	16,0%	4	0
1 < Emp. < 3	68,0%	17	2
3 < Emp. < 5	8,0%	2	4
More than 5 Employees	8,0%	2	5
Mean weight Value of Diploma's for 25 < Empl < 50 for 25 Companies		25	2,08
Mean weight Value of the sample	0,250		
Variance Value of the sample for Comp. with 25 < Empl. < 50	0,063		
Standard Deviation Value of the sample for Comp. with 25 < Empl. < 50	0,250		

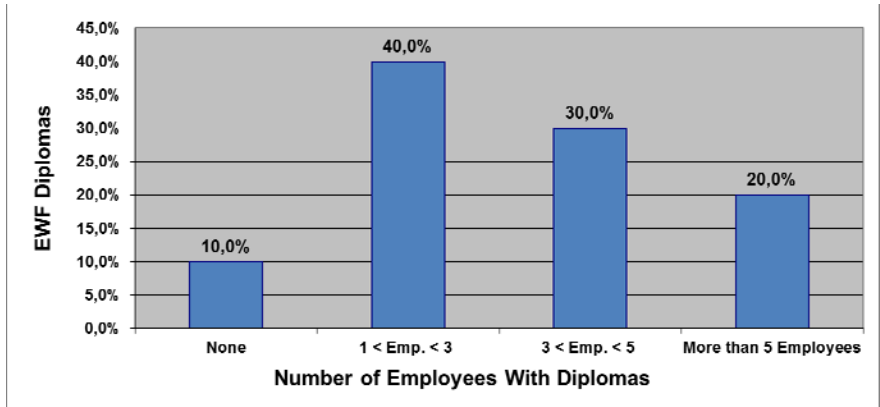
Table IV.7: Data regarding companies with between 25 and 50 Employees (engaged in welding activity)

Values for Companies 50 < Empl < 100	%	Number of Companies	Employees Weigh Value
None	17,6%	3	0
1 < Emp. < 3	41,2%	7	2
3 < Emp. < 5	11,8%	2	4
More than 5 Employees	29,4%	5	5
Mean weight Value of Diploma's for 50 < Empl < 100 for 17 Companies		17	2,76
Mean weight Value of the sample	0,250		
Variance Value of the sample for Comp. with 50 < Empl. < 100	0,013		
Standard Deviation Value of the sample for Comp. with 50 < Empl. < 100	0,113		

Table IV.8: Data regarding companies with between 50 and 100 Employees (engaged in welding activity)

Values for Companies Over 100 Employees	%	Number of Companies	Employees Weigh Value
None	10,0%	1	0
1 < Emp. < 3	40,0%	4	2
3 < Emp. < 5	30,0%	3	4
More than 5 Employees	20,0%	2	5
Mean weight Value of Diploma's for Companies over 100 Empl. for 10 Companies		10	3,00
Mean weight Value of the sample	0,250		
Variance Value of the sample for Comp. over 100	0,013		
Standard Deviation Value of the sample for Comp. over 100	0,112		

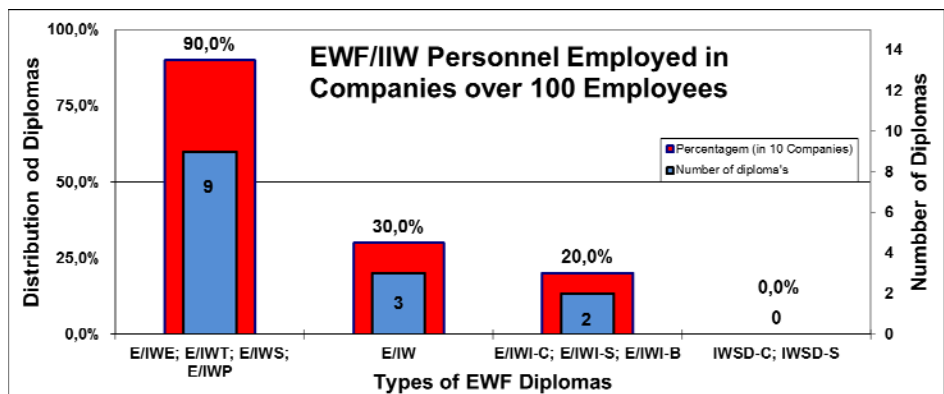
Table IV.9: Data regarding companies with over 100 Employees (engaged in welding activity)



IV.32: Distribution of the Amount of EWF/IIW Diplomas in Companies with over 100 Persons engaged in Welding

From the data above, regarding each company size sample it is possible to point out the following:

- i) In all charts related with the samples for each company size, the majority of the companies are employing between 1 to 3 persons with EWF/IIW Qualifications;
- ii) For small size and medium/small size companies almost 2/3 of the companies employ between 1 and 3 persons with EWF/IIW Qualifications;
- iii) Only 40% of medium size and big size companies are hiring between 1 and 3 persons with EWF/IIW Qualifications;
- iv) 29% of medium size and 20% of big size companies employ more than 5 persons with EWF/IIW Qualifications;
- v) Only big size companies show a significant percentage that hire between 3 and 5 persons with EWF/IIW Qualification, all the other types of companies do not present such value.



IV.33: EWF/IIW Types of Diplomas Distribution in Companies with over 100 Persons engaged in Welding

From the data above regarding each company size sample the most important information is regarding the distribution of EWF/IIW types of Diplomas, in all types of companies it is showed that the EWF/IIW Qualification most used is the qualifications regarding the welding coordination (EWE/IWE - Engineer; EWT/IWT - Technologist; EWS/IWS Specialist and EWP/IWP - Practitioner), followed by the

welders qualification and, Inspection personnel qualification and the qualification least mentioned is the designer.

With the above data regarding each company size sample it is possible to have a summary overview about the distribution of the number of EWF/IIW Qualified persons per “size” of company and also the distribution of types of EWF/IIW Qualification Diplomas on the companies sample.

This data was developed with the aim to obtain a relation between the number of employees and the number of EWF/IIW Qualified Personnel Employed on the Company.

From the charts of the previous sub chapter, it is possible to determine the average value for the number of EWF/IIW Qualified Personnel Employed (QPE), for each company size sample. On each company size sample, the mean weight value for the EWF/IIW Qualified Personnel Employed was determined using the following methodology:

- 1) Defining a weight for each range of EWF/IIW Qualified Personnel Employed

Range of QPE	weight
None	0
1 < Empl. < 3	2
3 < Empl. < 5	4
More 5	5

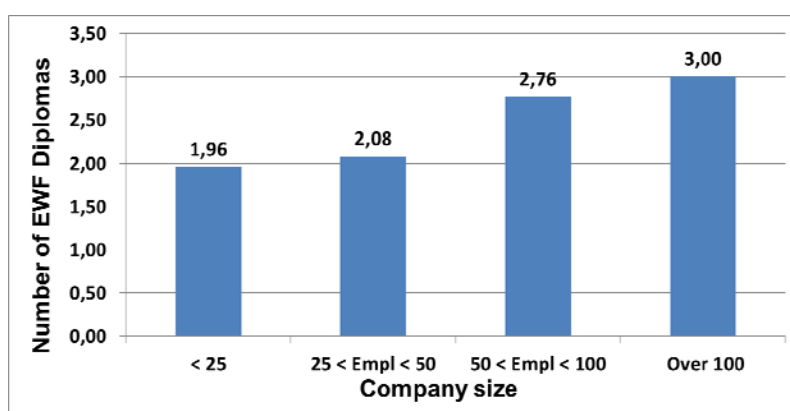
- 2) On each range it is known the number of companies (n), as an example for companies < 25 Employees, we have:

Range of QPE	Number of Companies
None	12
1 < Empl. < 3	29
3 < Empl. < 5	2
More 5	6

- 3) For each range, the number of companies was multiplied by the QPE weight, as an example for companies < 25 employees QPE between 3<Empl.<5, we have:  $n_i \times EW_i = 8$  (4x2)
- 4) For each company size sample, all the values obtained (like the example of item 3) were added and divided by the total number of companies of that sample, the value that was obtained it is the mean for QPE for each company size sample, as example for companies < 25 the mean value for QPE is: 1,96

Relation Between Number of EWF/IIW Employees and the Company Size	Mean Value
< 25	1,96
25 < Empl < 50	2,08
50 < Empl < 100	2,76
Over 100	3,00
Average of This Sample	2,451
Variance of the Sample	0,195
Standard Deviation of the Sample	0,441

Table IV.10: Data regarding the relation between number of EWF/IIW employees and the company size

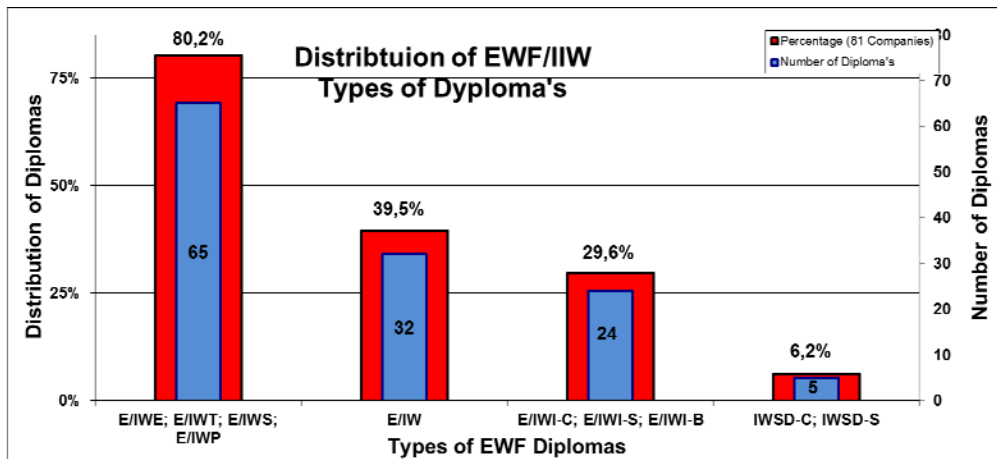


IV.34: Distribution of number of Qualified Persons per Company size

From the chart above it can be seen that the number of EWF/IIW Qualified Persons working in the companies is greater for companies with more people engaged in welding operations.

How EWF/IIW Types of Diploma's are distributed in the Companies:

Type of EWF/IIW Qualification	% of Companies that Employs EWF Personnel (total of 81 answers)	Total of Employees with EWF Qualification	<25	25 < Empl < 50	50 < Empl < 100	Over 100
<b>E/IWE; E/IWT; E/IWS; E/IWP</b>	80,2%	65	31	20	14	9
<b>E/IW</b>	39,5%	32	19	7	6	3
<b>E/IWI-C; E/IWI-S; E/IWI-B</b>	29,6%	24	16	4	4	2
<b>IWSD-C; IWSD-S</b>	6,2%	5	4	1	0	0
<b>Average of This Sample</b>	0,389					
<b>Variation of the Sample</b>	0,072					
<b>Standard Deviation of the Sample</b>	0,268					



IV.35: Distribution of the Type of Diplomas on the Companies Sample

The chart above confirms the distribution of the EWF/IIW qualifications that was shown on the previous sub chapter, meaning:

- i) The qualification level most hired by companies is related with welding coordination;
- ii) Welders is the second qualification hired by companies;
- iii) Inspection personnel is hired by 1/3 of the companies.
- iv) The designer qualification value is not significant yet.

#### **IV.6. BENEFITS FOR COMPANIES EMPLOYING STAFF AND/OR WORKERS WITH EWF/IIW DIPLOMAS**

##### **IV.6.1. INTANBIGLE BENEFITS FOR THE COMPANIES**

The charts below show the companies answers that mentioned to have EWF/IIW qualified people on their staff and working force regarding intangible benefits, these answers were not quantified, were only yes or no answers.

The sample of companies that have answered this part of the survey is 81 Companies.

Some more detailed charts are presented on annex 7.

From the companies answers sample (81 companies with personnel with EWF/IIW Diplomas as employees), it can be seen the great majority of Companies has found advantages in terms of several management aspects, as shown in Fig. IV. 36 and 37.

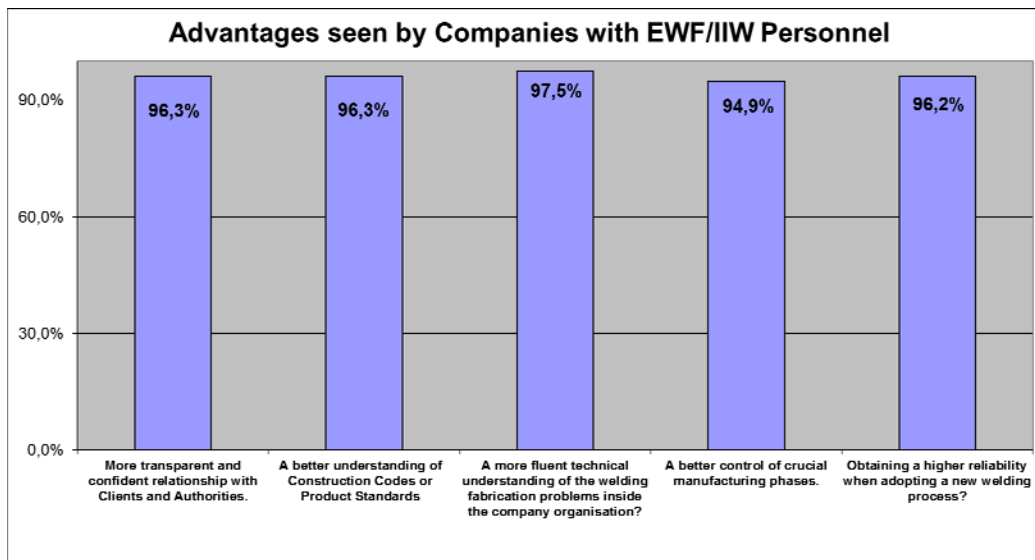


Fig. IV.36: Summary regarding the intangible benefits distribution

Other intangible benefits were pointed out by the companies. The more frequently mentioned were:

- i) Higher competitiveness, and productivity;
- ii) The company knowledge in materials and processes improved giving to the company the possibility to search for new markets;
- iii) The Welding Coordination is more able to give support to the shop floor working force;
- iv) A higher capability to give advice to clients in terms of new solutions;

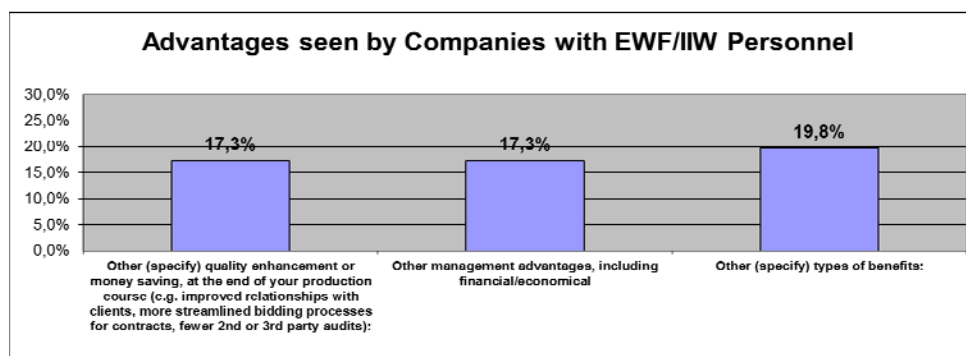


Fig. IV.37: Other Intangible Benefits distribution

#### IV.6.2. TANBIGLE BENEFITS FOR THE COMPANIES

The charts below shows the answers regarding tangible benefits. These answers were not quantified as they were only yes or no answers.

From the companies survey answers sample (81 companies with personnel with EWF/IIW Diplomas as employees), it can be seen the great majority of Companies has found advantages in terms of several tangible aspects, show in Fig. IV.38.

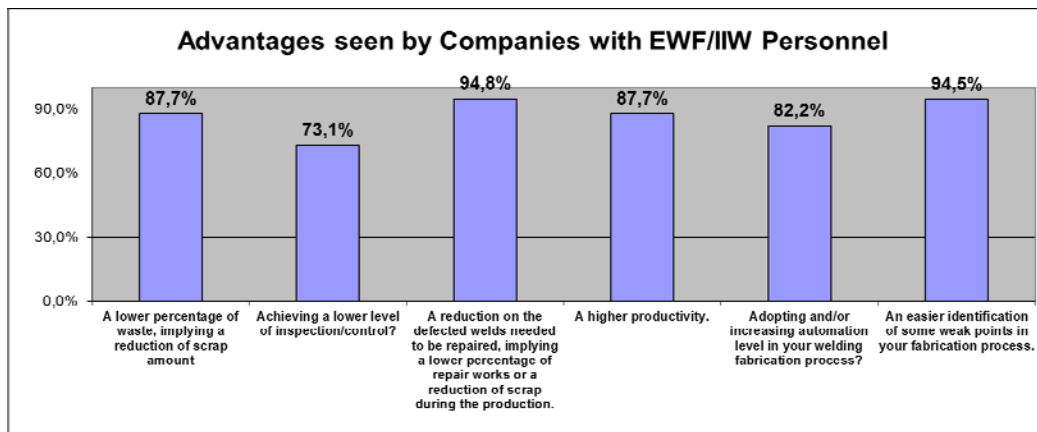


Fig. IV.38: Summary regarding the Tangible benefits

The data collected clearly demonstrates that skilled personnel bring tangible and intangible benefits to companies.

#### **IV.7. COMPANIES BENEFITS AND NUMBER OF EMPLOYEES WITH EWF/IIW QUALIFICATIONS**

##### **IV.7.1. METHODOLOGY USED FOR DATA ANALYSIS**

Considering the spread of results obtained in the survey, data was grouped in four levels, each one regarding the company size, and a statistical analysis was performed within each group of results.

Other three parameters were considered for evaluating the benefit of qualified personnel within the companies and these were: Scrap savings, welding repairs reduction and productivity gains.

The decision to use the above mentioned parameters was done considering each parameter will give accurate information regarding the company capability in terms of productivity and competitiveness in broad sense.

The goal of this statistical study is to understand the relation between the Ratio RD (Number of Diplomas/Company Size) and each of the above three mentioned parameters (scrap savings, welding repairs reduction, and productivity gains).

For this part of the study the calculations were made using the following relations:

- i) For each company the ratio (RD) was calculated between the number of qualified persons and the number of persons engaged in welding;
- ii) For each type of benefit, when the company as stated a certain gain value, the value was linked to the Company ratio RD;
- iii) For all companies with the same type of benefit, and the same ratio RD, a mean value for the benefit was calculated.

For the calculations the following assumptions were made:

- Mean value for the Company size:

Average Number of Company Employees (< 25) - 15

Average Number of Company Employees (25<Empl. <50) - 40

Average Number of Company Employees (50<Empl. <100) - 75

Average Number of Company Employees (>100) - 150

- Mean Value for the numbers of Qualified Persons per company:

Average Number of Diplomas (0) - 0

Average Number of Diplomas (1<Empl. <3) - 2

Average Number of Diplomas (3<Empl. <5) - 4

Average Number of Diplomas (>5) - 7

Some issues that are important to be clarified before the evaluation of the data, are the following:

- i) The number of companies who have quantified the benefits 15 companies in a sample of 101;
- ii) Some of the values mentioned by the companies were not used, since these were not in line with the average value for the ratio Diplomas-Company size.

**Scrap Savings:**

Ratio Diplomas/Company Size (RD)	0,01	0,03	0,05	0,13
Scrap Saving (mean value)	10%	12%	17%	11%

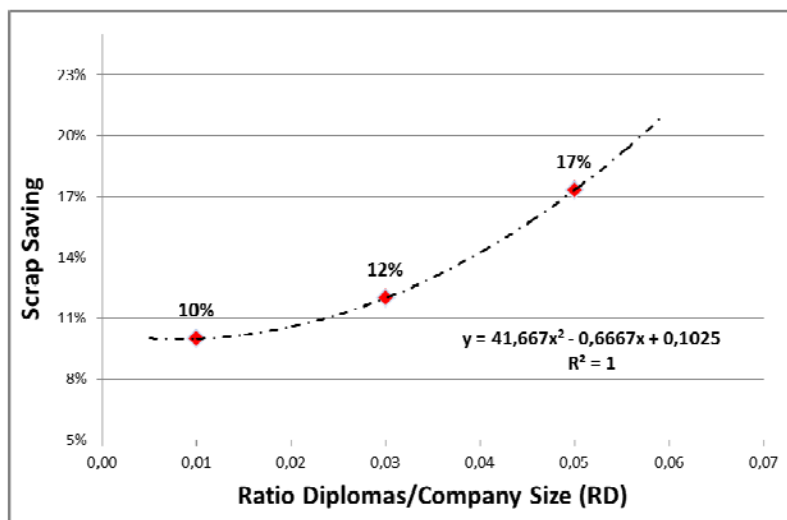


Fig. IV.39: Scrap saving versus Ratio Diplomas-Company Size

From the above values it is possible to notice the following:

- i) An increment in qualified people engaged in welding results in decreasing the amount of scrap. However, this increment is not infinite, it tends to stabilize to a certain value that was not possible to quantify due to the sample dimension;
- ii) To have more accurate figures for this type of analysis it is important to have larger samples, with the goal both to see what happens for higher ratio values, and also to refine the mean average of each ratio value. The same statement can also be applied to the charts below.

**Welding Repairs Reduction:**

Ratio Diplomas/Company Size (RD)	0,01	0,03	0,05	0,13
Scrap Saving (mean value)	10%	12%	17%	11%

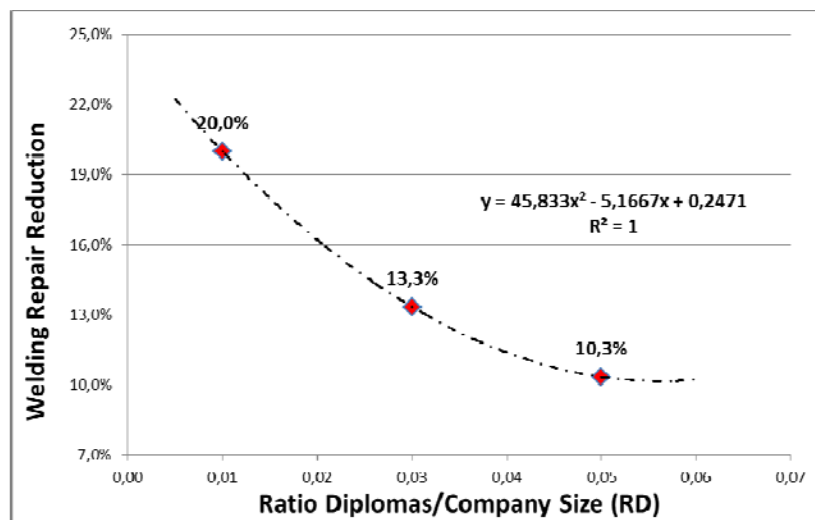


Fig. IV.40: Welding Repairs Reduction versus Ratio Diplomas-Company Size

From the above values it is possible to notice that when a company hire few qualified staff, a significant reduction of welding repairs is accomplished. The reduction expressed as a percentage on the overall welds tends to be smaller, even when this ratio increases.

**Productivity Gains:**

Ratio (RD) - Diplomas/Company Size	0,01	0,03	0,05	0,13	0,18	0,47
Gain in Productivity	8%	11%	9%	15%	20%	20%
Average of This Sample	13,5%					
Variance of the Sample	0,002					
Standard Deviation of the Sample	0,042					

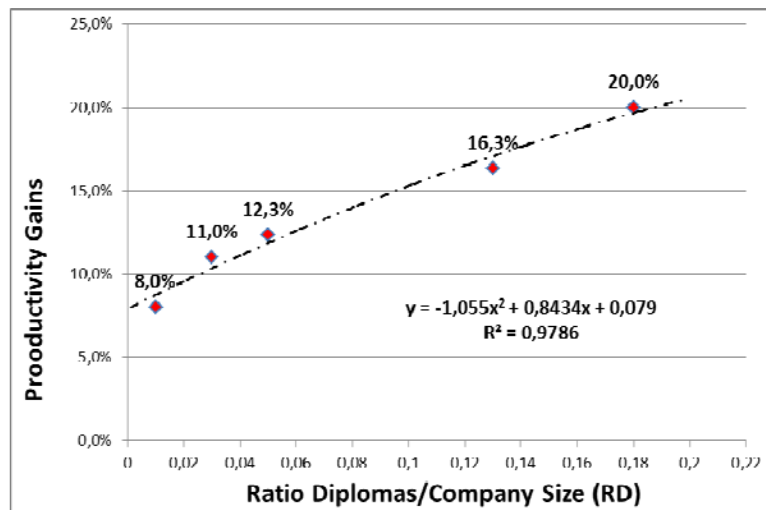


Fig. IV.41: Productivity Gains versus Ratio Diplomas-Company Size

From previous chart it can be seen that even with a few qualified persons, that is for small ratios between EWF diplomas and company staff size, the gains in productivity are significant and these increase with the number of qualified persons. It may be predicted from day to day experience that these will tend to stabilize for high RD values but from the data collected these tend to continuously increase.

#### **IV.8. ANALYSIS OF COMPANIES WITHOUT EWF/IIW QUALIFIED PERSONNEL**

All data below was gathered from twenty (20) companies survey answers, that have mentioned that they do not employ personnel with EWF/IIW Qualifications.

The goal of this data is to understand the main reasons for companies have not hired personnel with EWF/IIW Qualifications. Also this information can be used by EWF with the aim to develop strategies to reach this type of companies resulting in a higher market penetration and simultaneous answering the market needs.

All charts with the information gathered from the companies survey with no EWF/IIW Qualified Personnel can be seen on annex 8.

From the data redraw from the answers, it is possible to summarize the following:

- i) The majority of these companies do not know the EWF/IIW, therefore they do not know the added value from hiring qualified persons.
- ii) The majority of the companies also mention that they have not yet sent their staff to the EWF/IIW Qualification courses due to course duration and fees, as well as, the effect of training duration on the trainees activities in the company, which represent an additional cost.

- iii) They intend to hire persons with EWF/IIW Qualifications, and this is empowered by the chart below, where almost 2/3 of the companies assume they will have benefits if they hire qualified persons.

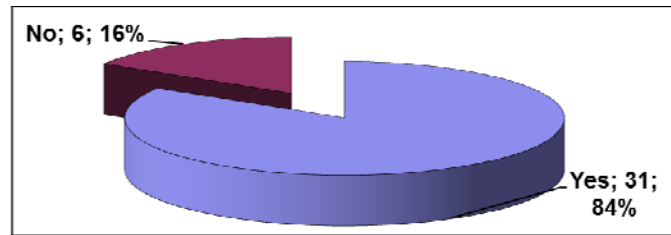


Fig. IV.42: Companies View Regarding the possible Benefits if they have EWF/IIW Qualified Persons

## **V.1. CONCLUSIONS AND SUGGESTIONS FOR FUTURE WORK**

From the study conducted and based on the gathered data from the companies survey, the general conclusions are:

1. Almost 50% of the answers were from small size companies, and all the others were in line with the typical distribution of companies size in any country, that is second group corresponds to small/medium size companies, the third to medium size ones and the smallest number of answers came from large companies;
2. One interesting conclusion from this study, it is at the moment the metalworking companies are more and more flexible units in terms of producing more than one type of fabrication. The study shows that more than 35% of the companies produce four or more types of products and almost 20% of the companies produce at least three types of products;
3. It is important to mention that the majority of the companies have two or more types of certification. When they have only two certifications it is typically EN ISO 9001 + EN ISO 3834 or EN ISO 9001 + DIN 18800-7. A good number of companies has three or more types of certification;
4. The most of the answers almost 70%, were sent by companies engaged in Contract Construction, Structures, Bridges, Machinery, Pressure Vessels, therefore it can be stated that the conclusions of this study can be applied to the majority of metalworking companies;
5. The distribution of the number of welding coordinators per company can be accepted as a normal distribution, if it is assumed that a welding coordinator is the responsible person for welding activities. However, this concept is against what is mentioned on EN ISO 14731 – Welding Coordinators – Tasks and Responsibilities, where it is stated that in each company a Responsible Welding Coordinator must be appointed, but the company can have more than one welding coordinator. With the increasing number of companies certified by EN ISO 3834, it will be reasonable to see in future that in each company the number of welding Coordinators will increase;
6. It is possible to draw a calculation method to determine the “better” number of welding coordinators per company taking into account the number of persons engaged in welding. This gives a good idea about the possible ratio between number of WC and the number of company personnel engaged in welding. For EWF, this information can be used to estimate the market for qualification of welding coordinators;
7. In terms of distribution of types of EWF/IIW Diplomas, the information gathered from the answers is in line with the distribution values of awarded diplomas. That is, the bigger group are the welding coordinators diplomas followed by the welders diplomas;
8. All the companies that employ persons with EWF/IIW mentioned that they have obtained gains either in intangible benefits or in tangible benefits;

9. In terms of intangible benefits the majority of companies over 95% of the answers, has marked each type of benefit, it can be concluded that companies see advantages when hiring persons with EWF/IIW Qualifications;
10. Regarding the tangible benefits, also the majority of the companies (over 80%) answers mentions they have reached gains on each type of benefit;
11. From the study, it can be concluded that there is a relationship between the Ratio RD (Number of Qualified Persons/Company Size) and Scrap reduction or Repair reduction or Productivity increase. That is, when a company has more qualified personnel on their staff, the reductions in scrap or repair will be higher or productivity will increase. Of course the reduction or increasing will not be always obtained, there will be a value where the data will stabilize. This behavior tends to a limit estimated around an RD of 0.07 for scrap and repair and 0.25 for productivity;
12. Regarding companies that do not employ EWF Qualified persons, it was stated by 84% of these companies, that they will benefit if they hire persons with EWF/IIW Qualifications, and at least 50% of the companies are considering in hiring this type of professionals.

### ***SUGGESTIONS FOR FUTURE WORK***

This study shows that there is a strong link between companies benefits and hiring qualified personnel with EWF/IIW Qualifications. It was also possible to conclude that there is a link between a minimum amount of qualified welding coordinators and the size of the company if the company wants to have the maximum gain in several tangible and intangible aspects. Nevertheless it was not possible in this study to have a high reliability for defining of trends or mathematical methods with the aim to give accurate information regarding the above mentioned relations. This was due to the number of answers and also because it did not cover all European Countries.

It will be important, regarding future work, to cover more companies in other countries in order to get more accurate data that should be crossed over with this study.

Estimations, using modelling, will be more reliable and thus will further contribute to define better strategies for EWF/IIW definition of new guidelines, with the aim to achieve a higher impact of these qualification systems on the metal working companies.

Another possible future work is the development of a total different survey to be sent to the same companies who have answered this survey study. This new study should aim to obtain new data and more comprehensive information regarding the welding coordination structure on each company. This survey will be important to verify how certified companies according to EN ISO 3834 are handling all the tasks and responsibilities that are under the welding coordination job function. This will lead to the identification of needs companies have in terms of new qualifications and/or could also be used by EWF/IIW members to define a better road map regarding the structure of the welding coordination, to develop guidance to be applied by the certified companies.

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# **Annexes**



## **Annex 1**

### **EFW Guidelines Summary**

EFW has also developed a set of training guidelines that covers other welding fields, and these are:

EWS-RW - Doc. EWF-525-01 – European Welding Specialist for Resistance Welding - Minimum Requirements for the Education, Examination and Qualification;

EWP-RW - Doc. EWF-621-06 – European Welding practitioner for Resistance Welding - Minimum Requirements for the Education, Examination and Qualification;

EAE - Doc. EWF-517-01 – European Adhesive Engineer - Minimum Requirements for the Education, Examination and Qualification;

EAS - Doc. EWF-516r1-10 – European Adhesive Specialist - Minimum Requirements for the Education, Examination and Qualification;

EAB - Doc. EWF-515r1-10 – European Adhesive Bonder - Minimum Requirements for the Education, Examination and Qualification;

EFW-UW - Doc. EWF-570-11 – European Manual Metal Arc (MMA)-Diver Welder - Minimum Requirements for the Education, Examination and Qualification;

ETSS - Doc. EWF-459r1-06 – European Thermal Spraying Specialist - Minimum Requirements for the Education, Examination and Qualification;

ETSP - Doc. EWF-592-01 – European Thermal Spraying Practitioner - Minimum Requirements for the Education, Examination and Qualification;

ETS - Doc. EWF-507r1-06 – European Thermal Spraying Sprayer - Minimum Requirements for the Education, Examination and Qualification.

#### **The Special Courses that has been developed by EFW are the following ones:**

Sc-Laser - Doc. EWF-494-01 – European Special Courses in LASER Welding - Minimum Requirements for the Education, Examination and Qualification, for the levels of Engineer, Technologist and Specialist;

Sc-Rob - Doc. EWF-530-01 – European Special Course for Robot Welding - Minimum Requirements for the Education, Examination and Qualification;

Sc-WINDTP - Doc. EWF-623r1-04 – European Special Course for Weld Imperfections for Non-Destructive Testing Personnel - Minimum Requirements for the Education, Examination and Qualification;

Sc-MMEx - Doc. EWF-627-07 – European Special Course for Personnel with the responsibility for Macroscopic and Microscopic Metallographic Examination of Structural Materials and their Joints Prepared/Produced by Welding and Allied Techniques - Minimum Requirements for the Education, Examination and Qualification;

Sc-WRB - Doc. EWF-544-01 – European Special Course for Welding Reinforcing Bars at the Specialist Level - Minimum Requirements for the Education, Examination and Qualification;

Sc-PRHT - Doc. EWF-628r1-10 – European Special Course for Personnel with the Responsibility for Heat Treatment of Welded Joints - Minimum Requirements for the Education, Examination and Qualification;

Sc-RMWF - Doc. EWF-640-07 – European Special Course for Risk Management in Welding Fabrication - Minimum Requirements for the Education, Examination and Qualification.

EFW has also developed two other training guidelines that are related with the rail activities, and these are:

EAW - Doc. EWF-635-07 – European Aluminothermic Welder - Minimum Requirements for the Education, Examination and Qualification;

EAWRJ - *European Arc Welder for Railway Tracks Joining (not yet published)*;

EAWRR - *European Arc Welder for Railway Tracks Reconstruction/Repair (not yet published)*.

## **Annex 2**

### **CEN and ISQ Standards and UE Directives that refer to EWF and IIW**

#### **Qualification System**

EWF or IIW Qualifications Systems are also referred on other EN and ISO standards and also in UE directives, below can be seen several examples.

#### **Welding standards for specific application:**

- i) EN 1090 series (issued in 2008 and 2009) - Execution of steel structures and aluminium structures, on part 1, 2 and 3, it is mentioned that welding coordination staff shall be appointed according to the requirements mentioned 14731 and also makes the mention to the EN ISO/TR 3834-6;
- ii) EN 12732:2000 – Gas supply systems – welding steel pipework – Functional requirements, in clause 4.3, makes the mention to EN 719 (this standard has been superseded by EN ISO 14731);
- iii) EN 15085-2:2007 - Railway applications - Welding of railway vehicles and components Part 2: Quality requirements and certification of welding manufacturer, in clause 5.1.2 makes the mention to EN ISO 14731, and also to the EWF Qualification Levels;
- iv) EN 13445-4:2009 - Unfired pressure vessels - Part 4: Fabrication, in clause 8.2, item c), sub item 1, makes the mention to EN 729 (this standard has been superseded by EN ISO 38334);
- v) EN ISO 14555:2006 - Welding – Arc Stud Welding of Metallic Materials, in clause 6.2, it is mentioned that the compliance with EN ISO 14731 is mandatory for the welding coordination staff and their level of competence;
- vi) EN ISO 17660-1: 2006 - Welding - Welding of reinforcing steel - Part 1: Load-bearing welded joints, in clause 9.1, makes the mention of EN ISO 14731 for the welding coordination staff, including in the informative Annex B, makes the mention to a certain EWF qualification;
- vii) EN ISO 17660-2:2006 - Welding - Welding of reinforcing steel - Part 1: Non Load-bearing welded joints, in clause 9.1, makes the mention of EN ISO 14731 for the welding coordination staff, including in the informative Annex A, makes the mention to a certain EWF qualification;
- viii) ISO 11745:2010 - Brazing for aerospace applications - Qualification test for brazers and brazing operators - Brazing of metallic components, in clause 4, on the note of this clause it makes a direct mention to the EWF/IIW Qualification level of Engineer;
- ix) ISO 24394:2008 - Aerospace series — Qualification test for welders and welding operators - Fusion welding of metallic components, in clause 5.2, it is stated the person(s) responsible for the qualification of the welder shall be a welding coordinator that complies with EN ISO 14731, even making the direct mention to the EWF/IIW Qualification level of Engineer.

***CEN standards and interconnections with European Union Directives***

EN 286-1:1996 + A1:2002 + A2:2005

Cited on EU-OJ: C229-1998-07-22, Applied on the EU Directives: 87/404/EEC; 2009/105/EC and 89/106/EEC

EN 1090 series

Will be cited on the EU-OJ on the last trimester of 2010, Applied on the EU Directive: 89/106/EEC

EN 12732:2000

Not Cited on EU-OJ, Applied on the EU Directives: 90/531/EEC and 93/38/EEC

EN 15085-2:2007

Not Cited on EU-OJ, Applied on the EU Directive: 93/38/EEC

EN 13445-4:2009

Cited on EU-OJ: C309-2009-12-18, Applied on the EU Directive: 97/23/EC

<b>Directive</b>	<b>Title</b>
87/404/EEC	On the harmonization of the laws of the Member States relating to simple pressure vessels
2009/105/EC	Simple Pressure Vessels (SPVD)
89/106/EEC	Construction Products Directive (CPD)
90/531/EEC	For procurement procedures of entities operating in the water, energy, transport and telecommunications sectors
93/38/EEC	For coordinating the procurement procedures of entities operating in the water, energy, transport and telecommunications sectors
97/23/EC	Pressure Equipment (PED)

Main EU Directives related with welding

## Annex 3

### The Survey

#### Metalworking-IIW System

##### The goals of this survey are:

1) To collect data regarding the implementation of the Training & Qualification (T&Q) System of the European Welding Federation (EWF) and/or the International Institute of Welding (IIW).



2) To understand how the EWF and/or IIW T&Q Systems have affected the company business if the company employ personnel with professional qualification in its staff and working force.

3) To understand what could be the main reasons for companies that do not have staff or workers with the professional Qualification from EWF and/or IIW T&Q System.

##### The survey it is divide in three main parts, they are:

###### Part A (Page 1 - questions 1 to 10):

Company Description (e.g. Country, Type of Product, Materials, Thickness range, Diameter range, Welding and Cutting Processes).

###### Part B (Page 2 - questions 11 to 22):

Welding Coordinators and other company staff and workers information regarding qualification background and if they have EWF or IIW Qualification Diplomas.

###### Part C (Page 3 - questions 23 to 40):

Gathering information regarding the relationship between company staff / workers with EWF and/or IIW T&Q professional qualification and company operating efficiency.

**Note:** This part of the survey shall be answered only by Companies who has hired personnel with EWF or IIW Qualification Diplomas

###### Parts D and E (Page 4 and 5 - questions 41 to 50):

Gathering information why the company as not hired persons with EWF or IIW Diplomas.

**Note:** If you have answered Part C, do not answer this part

###### Part F (Page 4 – question 51):

If the person who has answered the survey wants to add any information, this can be done in this part.

**All data collected in this survey will be considered confidential and will not be used for any commercial proposes.**

**Answering this survey will take less than 15 minutes.**

1) PART A - Company Description	
A.1 Name:	
A.2 Country:	
A.3.1 Person who answers this survey (Name):	

2) A.3.2 Company Job function of the person who is answering this survey:	
Welding Coordinator	
Production Manger	
Head of QA/DC Department	
Other (Please Specify):	

3) A.4 Is the Company Certified according to a certain Standard:	
Yes	
No	

4) A.4.1 If Yes, specify:	
ISO 9001 (quality system)	
ISO 3834 (quality requirements for fusion welding)	
ISO 14554 (quality requirements for resistance welding)	
ASME Stamp	
ISO 14001 (environment)	
OSHAS 18001 (healthy & safety)	
Other (Please Specify):	

5) A.5 Type of Products:
--------------------------

Contract Constructions (e.g. site erection, pipelines)	
Structures	
Bridges	
Machinery	
Pressure Vessels	
Chemical Reactors	
Offshore Equipment/Products	
Transportation – air, aerospace	
Transportation – automotive	
Transportation – boats, ships	
Transportation – railroad	
Fabricated metal products – sheet metal (e.g. furniture, electrical boards)	
Other (Please Specify):	

6) A.6 Type of Parent Material(s) used:	
Mild Steels (C-Mn)	
Fine Grain Steels	
Quenched & Temper Steels	
Ni Steels (cryogenic applications)	
Heat Resistant Steels (e.g. Cr Mo)	
Austenitic Stainless Steels	
Duplex Stainless Steels	
Ferritic Stainless Steels	
Martensitic Stainless Steels	
Aluminium and & Al Alloys	
Nickel and Ni alloys	
Cast Iron	

Other (Please Specify):

7) A.7 Parent material Form/Shape, Thickness and Diameter (OD):	
A.7.1 Parent Material Form/Shape	
Plate	
Tube/Pipe	
Other forms (e.g. H, I beams), specify:	

8) A.7.2 Thickness Range (mm)	
Less than 3	
$3 < t < 5$	
$5 < t < 15$	
$15 < t < 35$	
Over 35	

9) A.7.3 Diameter (OD) Range (mm)	
Less than 25	
$25 < t < 62,5$	
$62,5 < t < 100$	
Over 100	

10) A.8 Welding and Cutting Processes (Process Code according to ISO 4063:2009):	
MMA (111)	
TIG (141 other variants 14X)	
FCAW (Self Shielded - 114)	
MIG (131)	
MAG (135)	
FCAW (Basic and Rutile - 136)	

FCAW (Metal Core - 138)	
SAW (121, other variants 12X)	
PAW (15 other variants 15X)	
Resistance Spot Welding(211, 212)	
Resistance Seam Welding(22X)	
Resistance Projection Welding (23X)	
Oxigas (311, 312)	
Electron Beam (52X)	
LASER (53X)	
Stud (26, 78X)	
Flame Cutting (81)	
Arc Cutting (82X)	
Plasma Cutting (83X)	
LASER Cutting (84)	
Flame Gouging (86)	
Arc Gouging (87X)	
Plasma Gouging (88)	
Brazing, Soldering and Weld Brazing (9XX)	
Other Processes (welding, cutting or gouging) specify:	

11) B. Welding Coordination	
B.1.A Has the Company formally appointed Welding Coordinator(s) (ISO 14731)	
Yes	
No	

12) B.1.B If the answer is **No**, please give a short explanation why (if possible):

13) B.1.C If the answer on question B.1.B was **No**

How the welding coordination activities on the company fulfil the tasks as described in EN ISO 14731 Appendix B, please give a short explanation if possible:

14) B.2 How many Welding Coordinators (WC) or person(s) that fulfil the duties and functions of a welding coordinator (ISO 14731), does the Company have?

None	
1	
2 < WC < 3	
More than 3	

15) B.3 At your company how many persons are engaged in the welding activities, including production, management, planning, QA/QC, design?

< 25	
25 < Persons < 50	
50 < Persons < 100	
More than 100	

16) B.4 Is the company informed about the EWF – European Welding Federation Personnel Qualification System (or the IIW – International Institute of Welding) in the field of welding technology?

Yes	
No	

17) B.5 Does the Company employ staff or workers that have EWF (or IIW) Qualification Diplomas?

If the answer is **No**, do not answer the questions of **item C (page 3)** of this survey.

Yes	
No	

18) B.6 How many employees have a EWF (or IIW) Qualification Diploma?

None	
------	--

1 < Emp. < 3	
3 < Emp. < 5	
More than 5 Employees	

19) B.7 Please specify the academic level of the Welding Coordinator(s) (mark more than one if needed, e.g. if there are more than 1 welding coordinator in your company)	
Compulsory Education	
Professional Vocational Qualification	
Technical College Diploma	
University Engineering Diploma	
EWF or IIW Qualification Diploma (e.g.: EWE/IWE; EWT/IWT; EWS/IWS; EWP/IWP)	

20) B.8 Please specify the academic level of the Welding related staff or workers (e.g: Welders, QA/QC personnel, designers, etc.)	
B.8.1 Welders	
Compulsory Education	
Professional Vocational Qualification	
EWF or IIW Welder Qualification Diploma (e.g.: EW/IW)	

21) B.8.2 QA/QC Personnel (welding inspection)	
Compulsory Education	
Professional Vocational Qualification	
Technical College Diploma	
University Engineering Diploma	
EN or ISO or ASNT Certification	
Welding Inspector Certification (e.g. AWS, CSWIP, National)	
EWF or IIW Inspectors Qualification Diploma (e.g.: EWI-C/IWI-C; EWI-S/IWI-S and EWS-B/IWI-B)	

22) B.8.3 Designers	
Compulsory Education	
Professional Vocational Qualification	
Technical College Diploma	
University Engineering Diploma	
IIW Designer Qualification Diploma (e.g.: IWSD-C or IWSD-S)	

**23) Go directly to Item D (page 4), if your Company does not employ personnel that have a EWF (or) IIW Qualification Diploma, do not answer Item C (page 3).**

C.1 If the company has employees with EWF (or IIW) Qualification Diplomas, do you think that the company has experienced any management advantages in terms of having qualified people with a Diploma recognised Internationally, such as :

C.1.1 More transparent and confident relationship with Clients and Authorities.

Yes	
No	

24) C.1.2 A better understanding of Construction Codes (e.g. AWS D1.1, API 1104, ASME) or to Product Standards (e.g. EN 1090, EN 15085, EN 13480, EN 13445) or EU Directives

Yes	
No	

25) C.1.3 A more fluent technical understanding of the welding fabrication problems inside the company organisation?

Yes	
No	

26) C.1.4 Other management advantages, including financial/economical (specify):

27) C.2 If the Company has employees with EWF (or IIW) Qualification Diplomas, do you think that

the company, has experienced any quality enhancement or money saving, at the end of your production course, such as:

C.2.1.A - A lower percentage of waste, implying a reduction of scrap amount

Yes	
No	

28) C.2.1.B - Is it possible to quantify? If yes give a percentage of reduction and/or the saving figures:

29) C.2.2.A - A reduction on the defected welds needed to be repaired, implying a lower percentage of repair works or a reduction of scrap during the production.

Yes	
No	

30) C.2.2.B - Is it possible to quantify? If yes give a percentage of reduction and/or the saving figures:

31) C.2.3.A - A higher productivity.

Yes	
No	

32) C.2.3.B - Is it possible to quantify? If yes give a percentage regarding the productivity gained:

33) C.2.4 A better control of crucial manufacturing phases.

Yes	
No	

34) C.2.5 An easier identification of some weak points in your fabrication process.

Yes	
No	

35) C.2.6 - Other (specify) quality enhancement or money saving, at the end of your production course (e.g. improved relationships with clients, more streamlined bidding processes for contracts, fewer 2nd or 3rd party audits):

36) C.3 If company has employees with EWF (or IIW) Qualification Diplomas, do you think that the company, has felt any benefits in, i.e.:

C.3.1 Obtaining a higher reliability when adopting a new welding process?

Yes

No

37) C.3.2 Achieving a lower level of inspection/control?

Yes

No

38) C.3.3 Adopting and/or increasing automation level in your welding fabrication process?

Yes

No

39) C.3.4 - Other (specify) types of benefits:

40) C.3.5 Regarding the **C.3 Questions** is it possible to give a figure in euro regarding the savings that were obtained?

41) **Please go to Item F (page 6), if you have answered item C.**

D. If the company has no employees with EWF (or IIW) Qualification Diplomas, this is due to .....

D.1 The company does not have any information regarding the EWF and/or IIW Personnel Qualification system

Yes

No

42) D.2 The costs of the training according to the EWF and/or IIW Personnel Qualification System?	
Yes	
No	

43) D.3 The duration of the EWF and/or IIW training courses?	
Yes	
No	

44) D.4 The difficulty of management of the training periods with the production schedule?	
Yes	
No	

45) D.5 The clients do insist on the Company to have Welding Co-ordinators with a formal recognised welding qualification, like it is stated on the ISO 14731 – Welding Coordination – Tasks and Responsibilities?	
Yes	
No	

46) E. If the company has no employees with EWF (or IIW) Qualification Diplomas, do you think that .....  E.1 The Company has the proper qualified employees to carry on the welding coordination tasks and other welding related activities.	
Yes	
No	

47) E.2 The company's clients have ever claimed the company should have employees with the EWF (or IIW) Qualification Diplomas.	
Yes	
No	

48) E.3 The Company is thinking of hiring personnel with EWF (or IIW) Qualification Diplomas.	
Yes	
No	

49) E.4 If the Company is certified according to ISO 3834 or ISO 14554, what route was used to recognise the Welding Coordinators?	
Technical interview by the Auditors	
Documental review regarding the CV and other evidences	
Other (Please Specify):	

50) E.5 If the company has staff with a EWF (or IIW) Qualification Diplomas, do you think this could bring the company some technical advantages and/or higher productivity and/or less welding repairs?	
Yes	
No	

51) F. If you think that this survey did not cover any specific issue regarding the relationship between the company productivity and the qualifications of the company employees, feel free to write below your ideas:
---

**The survey has finished.**

**We thank you for the time you have spent answering this survey.**

The information you have provide it is very important for the propose of this project.

If you feel the need to contact the responsible person for this survey you should use the following contact - ijfernandes@isq.pt, Italo Fernandes – EWF-IAB/IIW Secretariat – System Manager

## Annex 4

### Survey On Line Information

Internet address of the on line survey tool - <http://www.freeonlinesurveys.com/>

To develop the survey, the login to be used was:

User: mcpscada@isq.pt

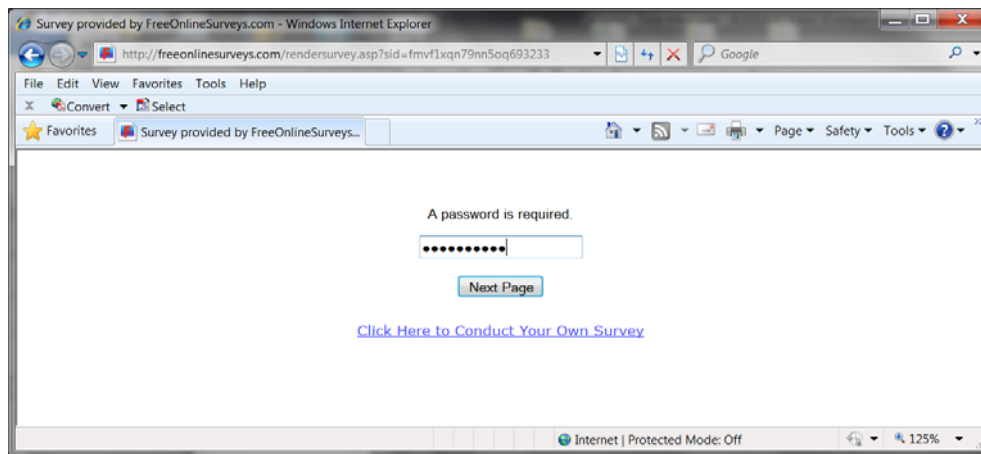
Password: XXXXXX

After the survey was developed a link was created to open the survey:

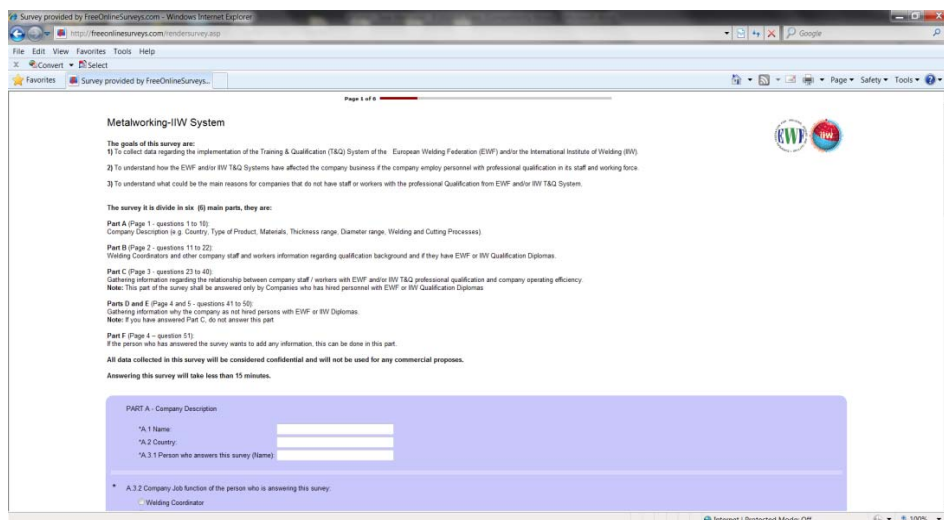
<http://FreeOnlineSurveys.com/rendersurvey.asp?sid=fmvf1xqn79nn5oq693233>

Password to open the survey: EWFSYSTEM

See below two screens, the first when the link is opening asking for the password



The second screen is the first screen after opening the on line survey

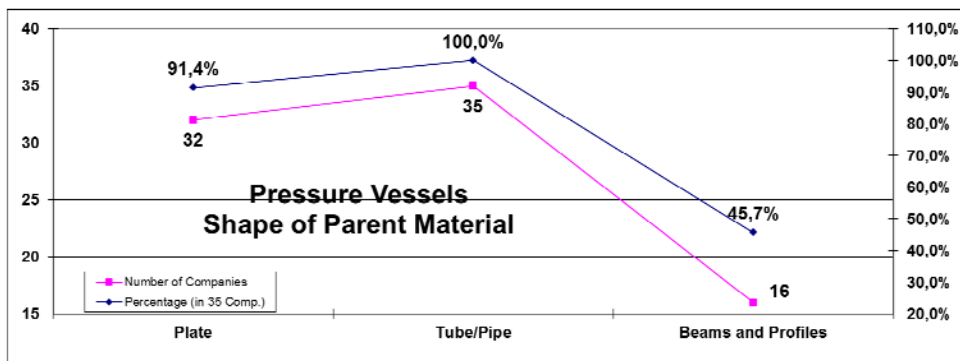
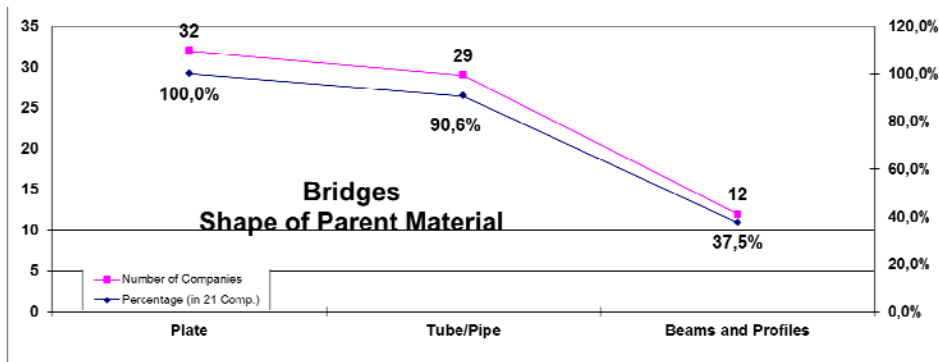
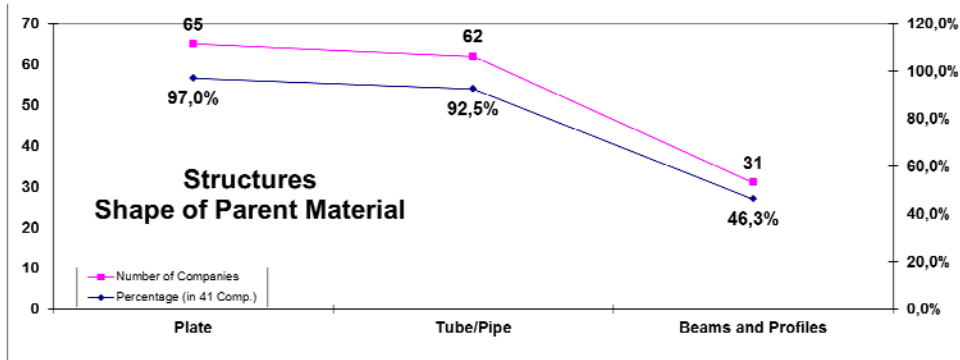
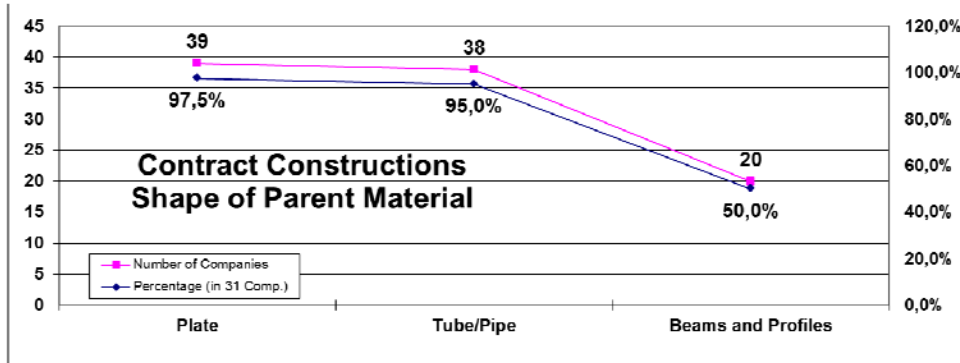




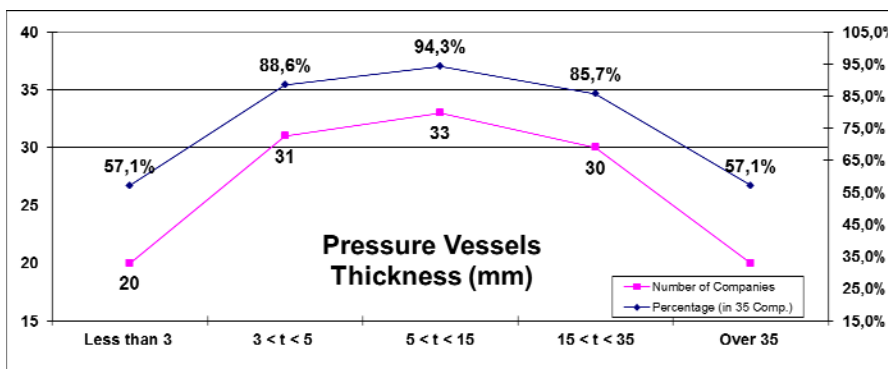
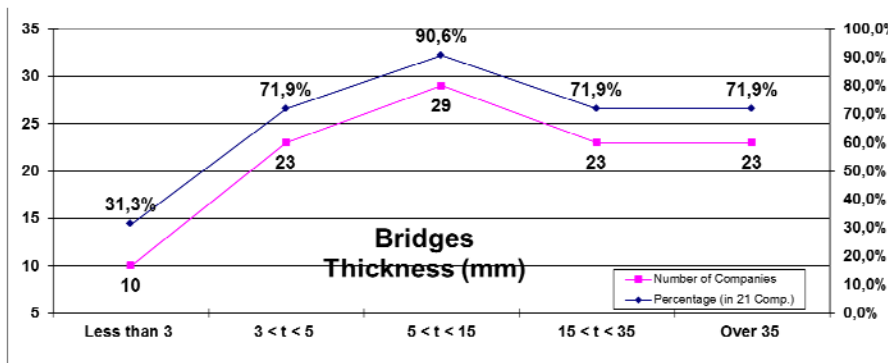
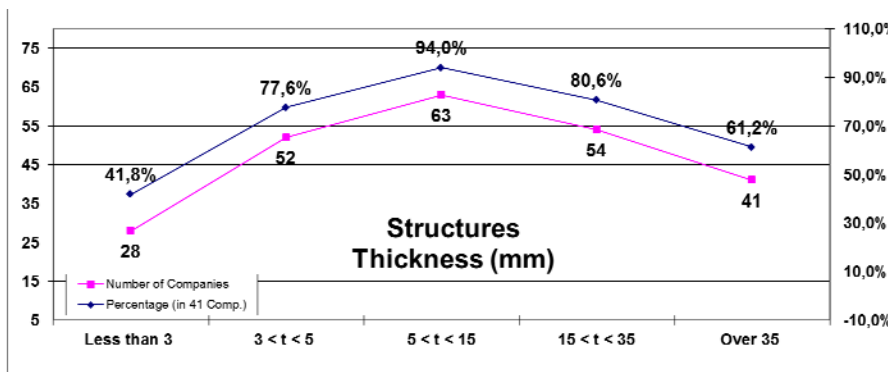
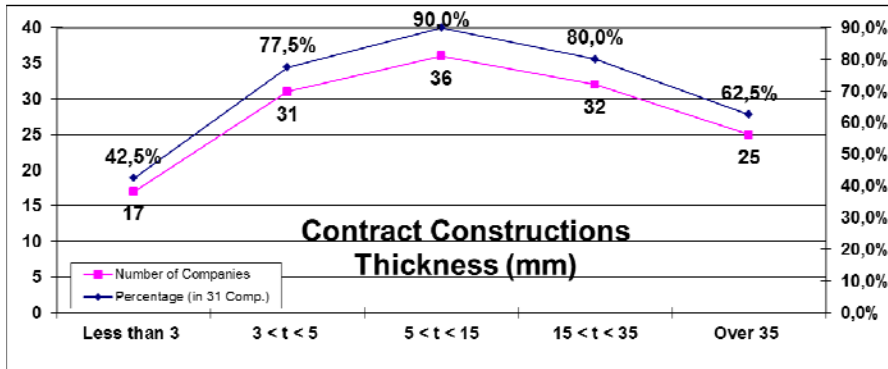
## Annex 5

### Examples of Type of Products Manufactured and related raw materials, form/shape, thickness and diameter

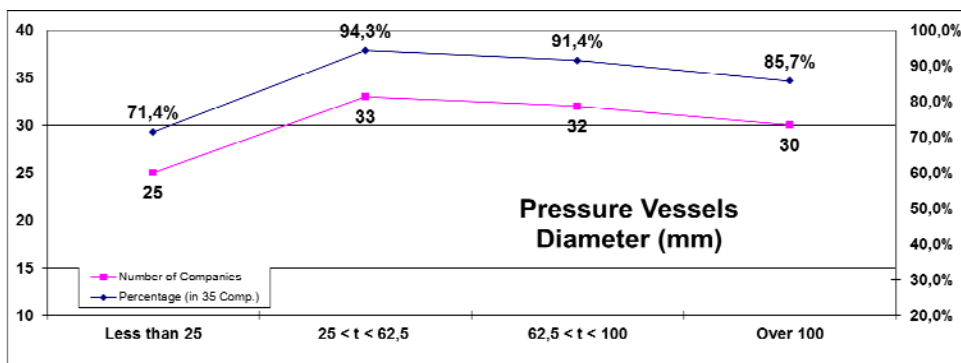
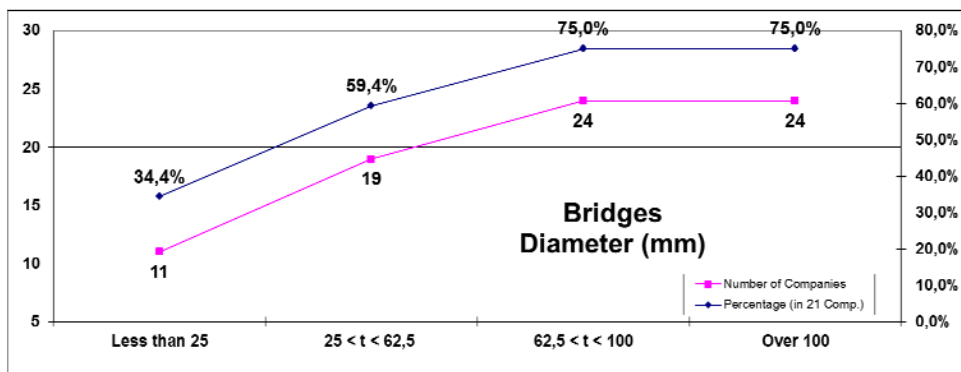
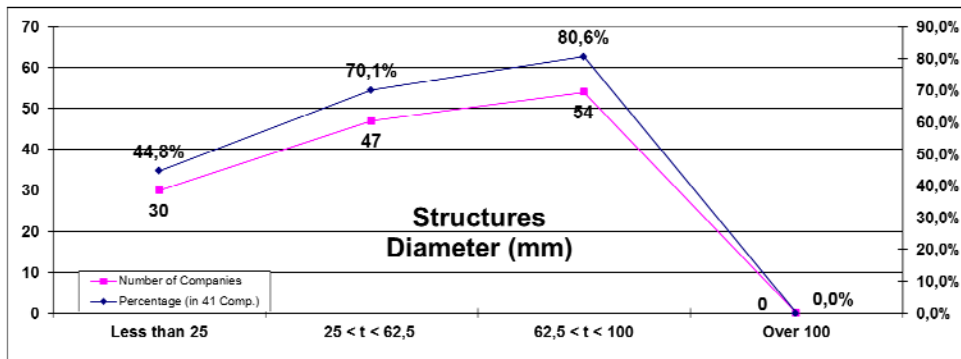
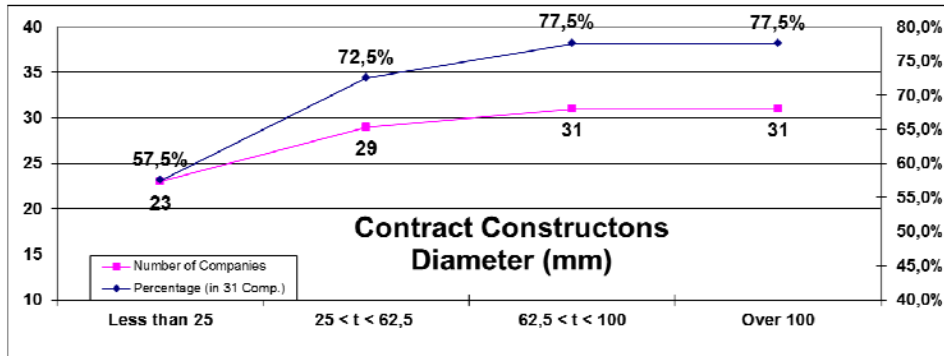
From and Shape of Raw Materials:



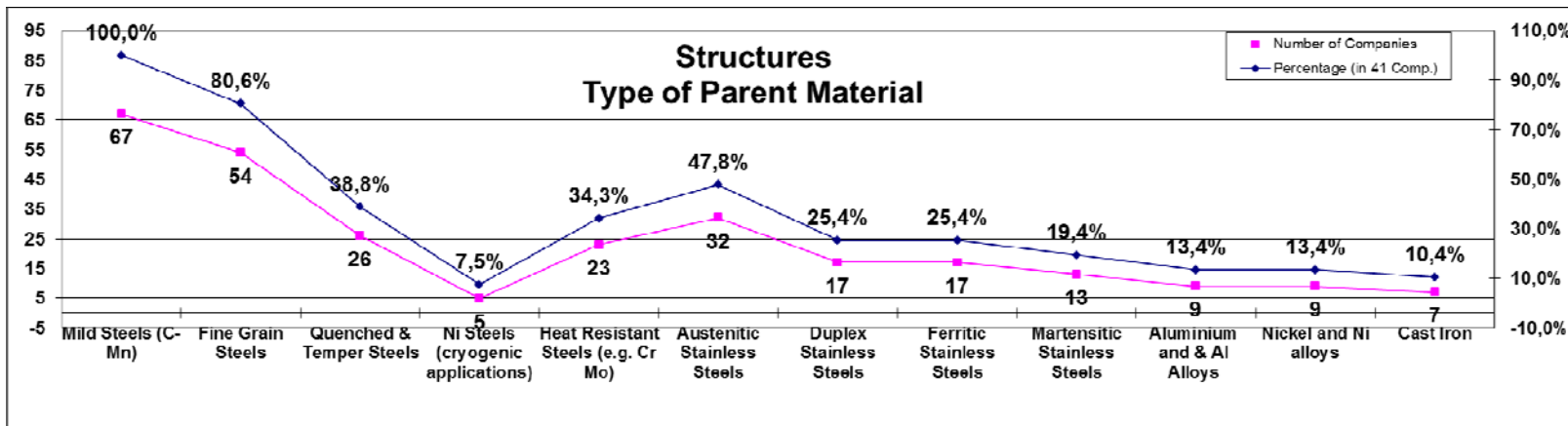
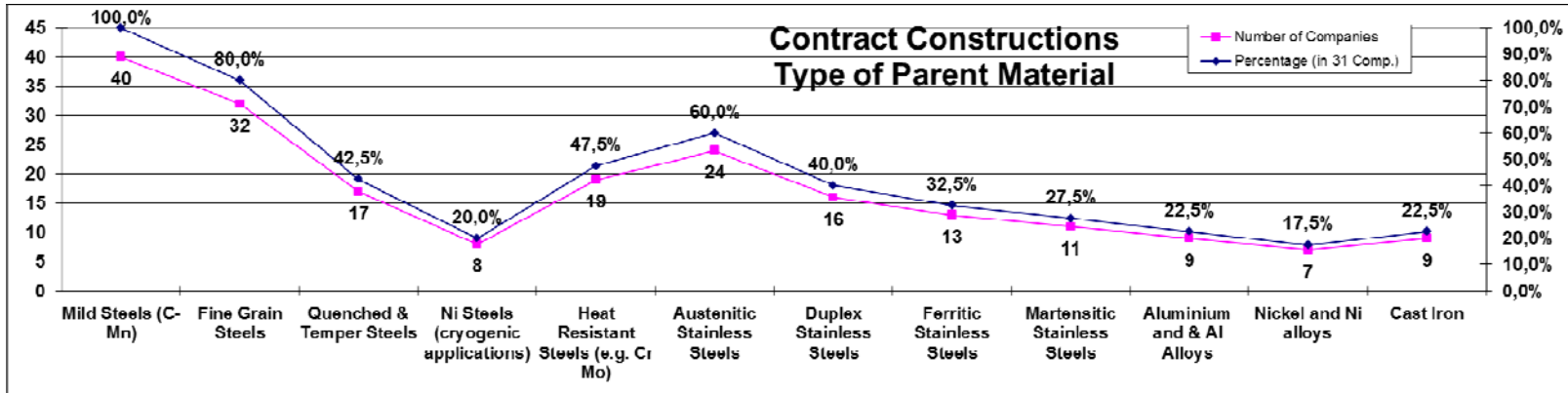
Raw Material Thickness:

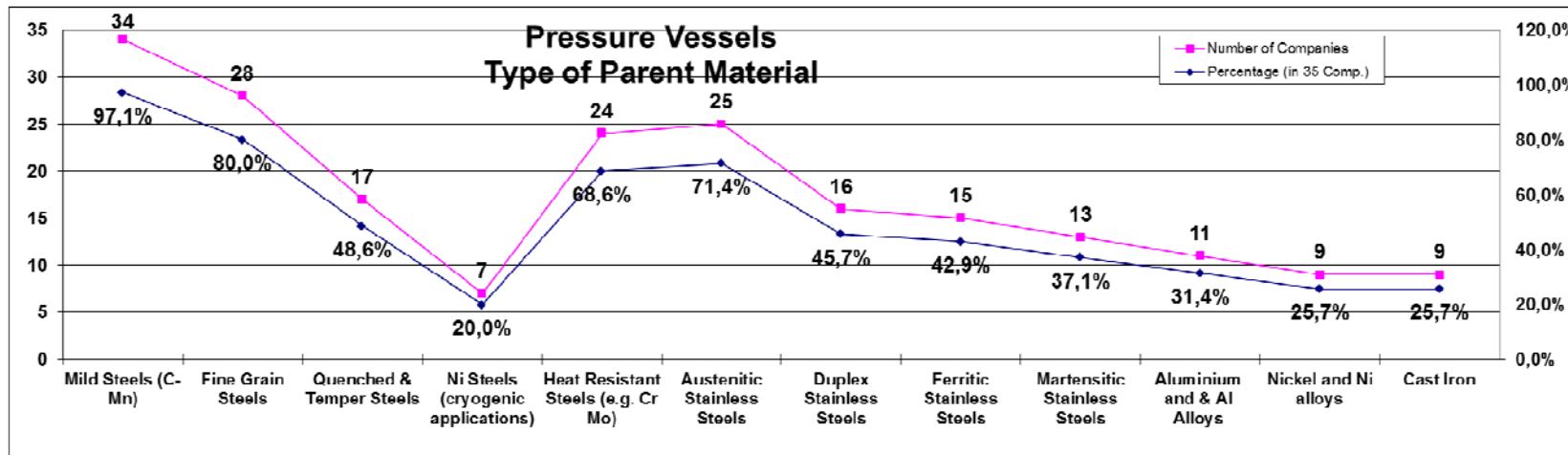
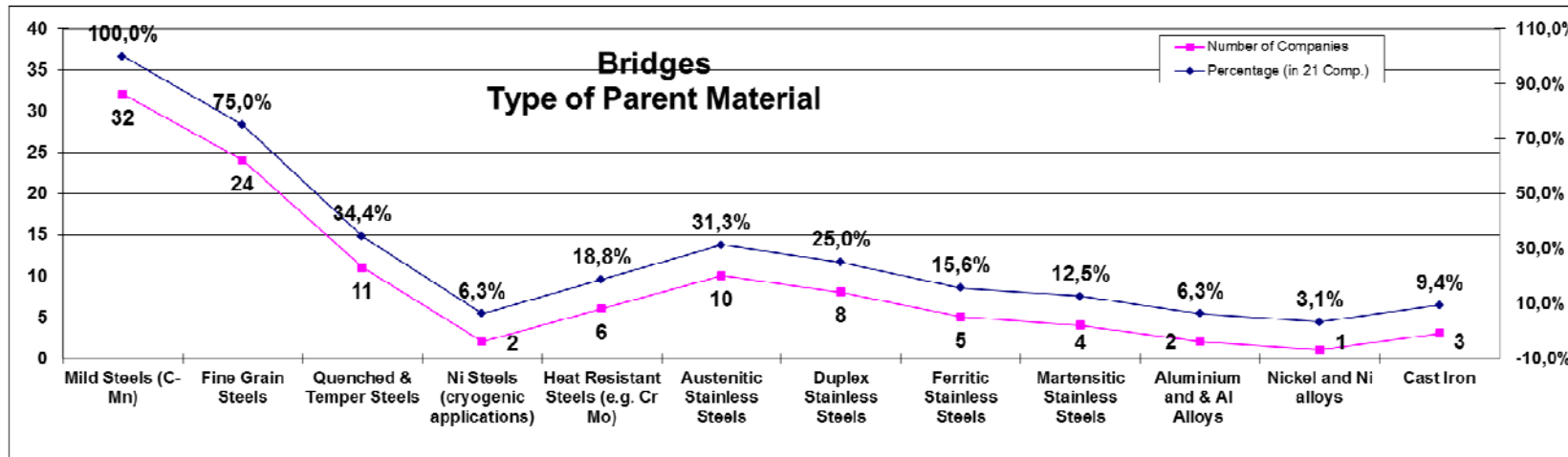


Raw Material Diameter:



Raw Materials:



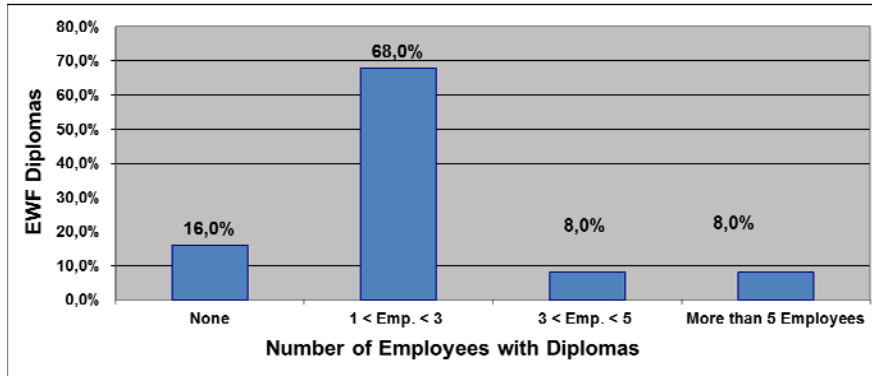




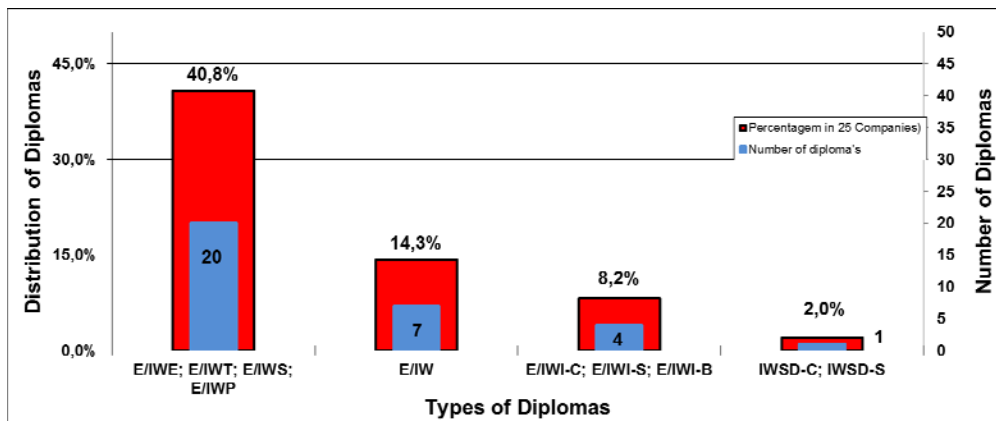
## Annex 6

### Charts Regarding the Distribution of EWF/IIW Qualified Personnel employed by the companies

#### Companies with between 25 and 50 Employees (engaged in welding activity)

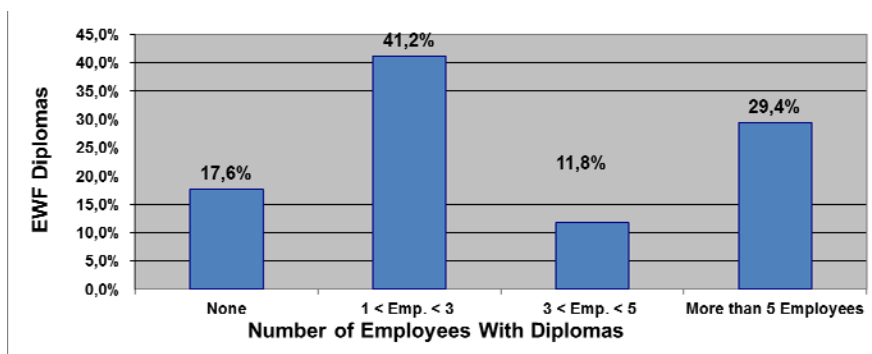


Distribution of the Amount of EWF/IIW Diplomas in Companies with 25 and 50 Persons engaged in Welding

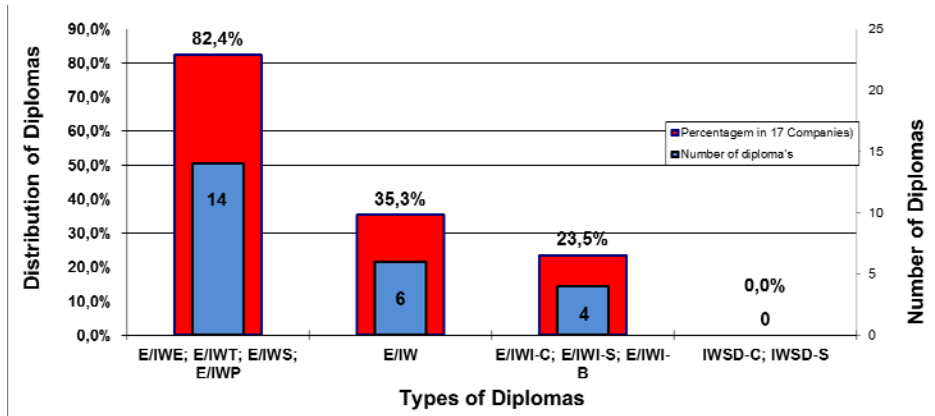


EWF/IIW Types of Diplomas Distribution in Companies with 25 and 50 persons engaged in Welding

#### Companies with between 50 and 100 Employees (engaged in welding activity)



EWF/IIW Types of Diplomas Distribution in Companies with 50 and 100 Persons engaged in Welding

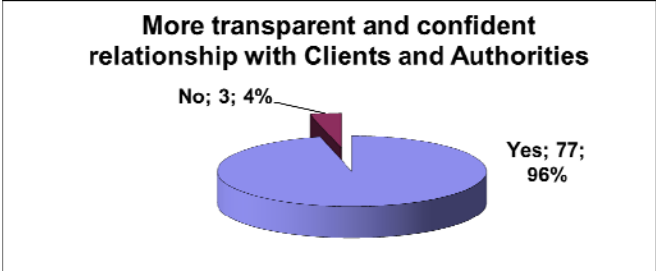


Distribution of the Amount of EWF/IIW Diplomas in Companies with 50 and 100 Persons engaged in Welding

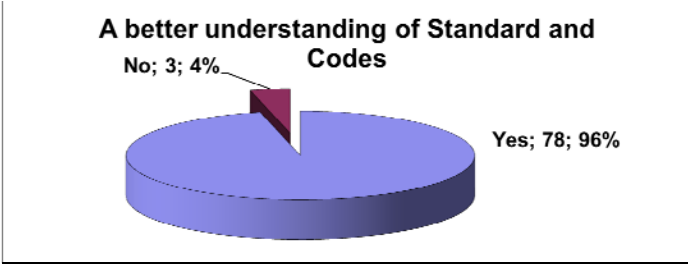
**Annex 7**

**Charts Regarding the Benefits for Companies Employing Staff and/or Workers with EWFIW Diplomas**

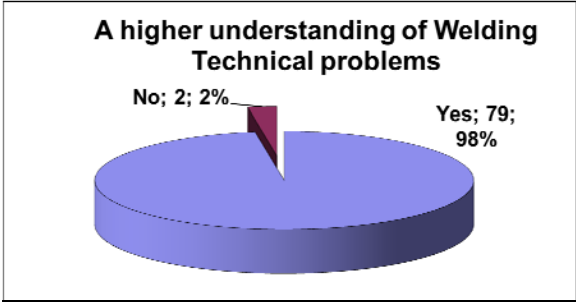
**Intangible Benefits:**



Benefit Regarding the Company Relation with Authorities and Clients

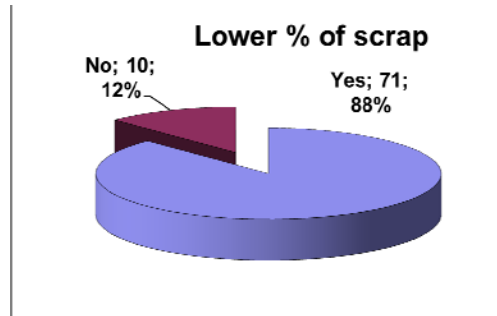


Benefit Regarding Understanding the Construction Codes and Standards

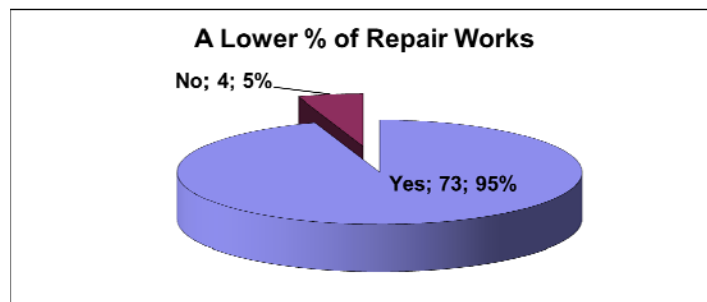


Benefit Regarding the Welding Technical Problems Understanding

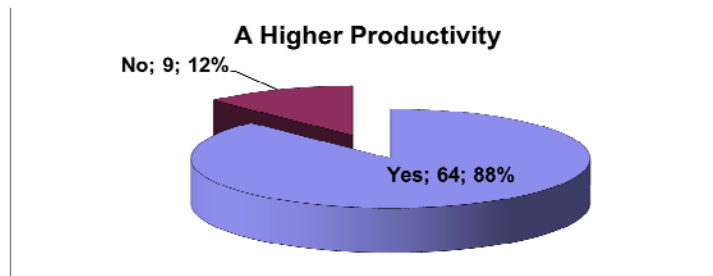
**Tangible Benefits:**



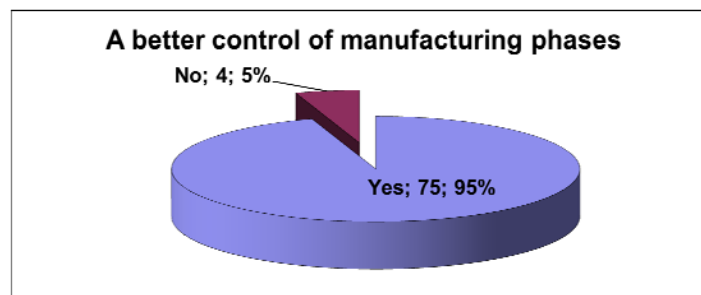
Reduction of Scrap



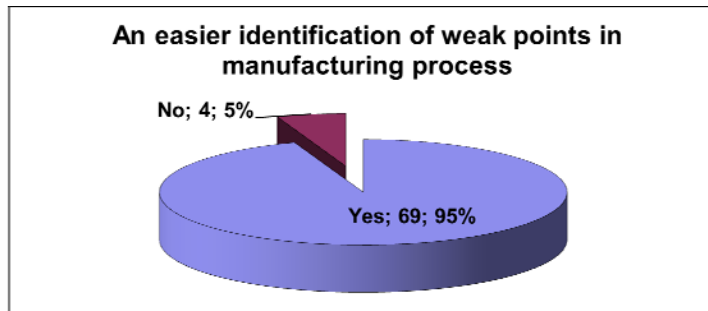
Reduction of Repair Works



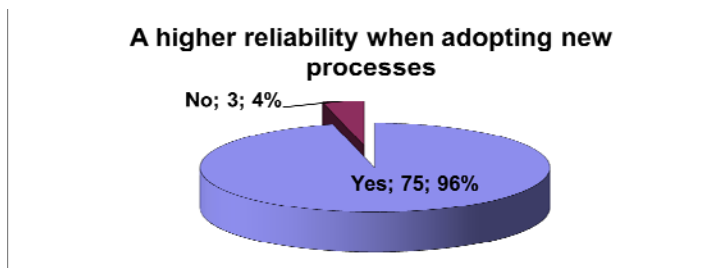
Productivity Increment



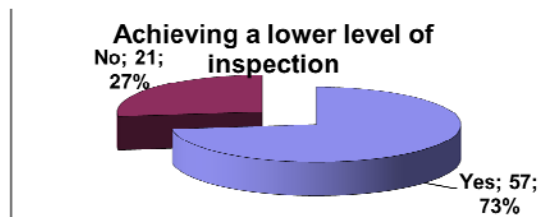
Control of Manufacturing Phases



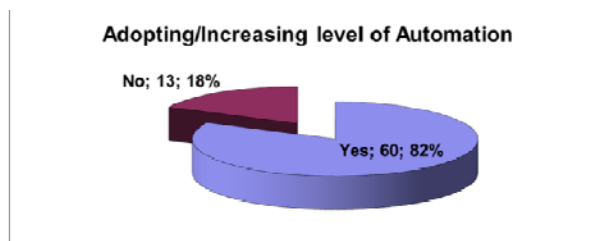
Identification of Weak Points during Manufacturing



Reliability when Introducing new Processes



Reduction the amount of Inspection



Adopting/Increasing the level of Automation

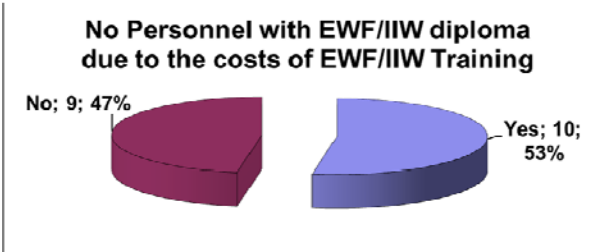


**Annex 8**

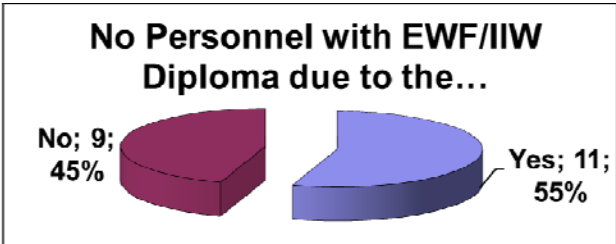
**Charts Regarding the Data from Companies who have answered they have not employees with EWF/IIW Qualifications**



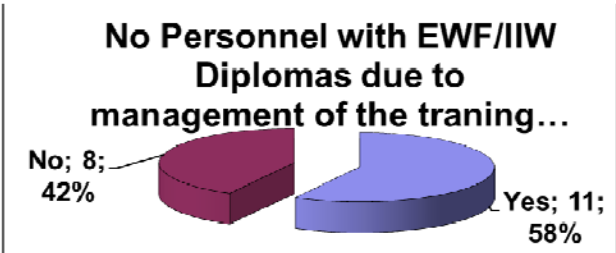
Companies Knowledge Regarding the EWF/IIW Qualification System



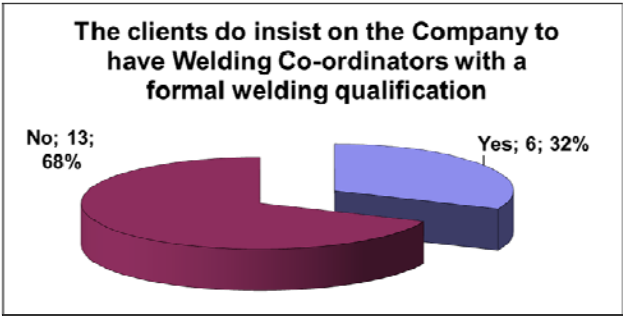
EWF Training Costs as Reason to have not employees with EWF//IIW Diplomas



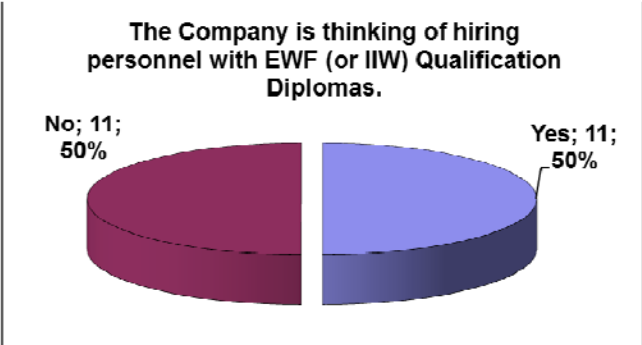
EWF Training Courses Duration as Reason to have not employees with EWF//IIW Diplomas



Difficulty in doing the management of training periods and professional activities at the Company as Reason to have not employees with EWF//IIW Diplomas



Companies Clients request or not to Company to have welding coordinators with formal qualification



Companies View Regarding their position in terms of hiring EWF/IIW Qualified Persons