INTERNATIONAL HARMONISED EDUCATION AND TRAINING IN MANUFACTURING TECHNOLOGY – The case of Welding

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Abstract: The European market is lacking qualified professionals in manufacturing technologies, welding technology in particular is one of the few areas where job offers are higher than job seekers. The importance of welding to the global economy is known to be of significant relevance though estimations of its real impact done on a study conducted by EWF and DVS in 2013. This thorough study, based on collection of data, statistical analysis and modelling, led to results that show that the total added value generated by European joining industry is around 66 Billion Euros per year and estimates that just over 1.2 million people work in welding and related technologies. EWF is a welding organisation in which international expertise in welding and related technologies is assembled which manages a harmonised international system for education, training, qualification and certification of welding personnel used in 43 countries around the world. For more than 20 years, these organisations have been developing guidance documents and technology exchange mechanisms to support companies seeking to adopt best practice in welding. This has been a monumental effort, culminating in the installation of unique and comprehensive training, qualification and certification systems, applied to both people and companies, harmonised on a world-wide basis.

This paper gives details of the EWF systems that have been developed and what has been achieved as a result of them. It also outlines the challenges ahead for EWF and how they are being addressed.

Keywords: TRAINING, QUALIFICATION, CERTIFICATION, WELDING, QUALITY

1. Introduction and Background

The importance of welding to the global economy is known to be of significant relevance though estimations of its real impact done on a study conducted in Germany in 2013. This thorough study, based on collection of data, statistical analysis and modelling, led to results that show that the total added value generated by European joining industry is around 66 Billion Euros per year and estimates that just over 1.2 million people work in welding and related technologies. Welding technology is, in fact, used in most of the manufacturing companies. [1]

It is also well known that, if welding is not done properly, catastrophic failure of constructions can occur which create serious damage to people and also represent significant economic losses. Two examples are shown in Figure 1. These were both caused by brittle fracture initiating from a weld defect. Fortunately such occurrences are reduced these days, but mistakes in welding can be costly for other reasons. For example it has been estimated that the cost of repairing an unacceptable weld can cost 5 to 6 times the cost of welding it correctly in the first time. [2]

![Fig. 1 Failure of welded structures.](image)

Safety and profit depend on technical control of welding operations. Key staff in all welding related activities needs to have an appropriate level of competence in welding technology and its application. In addition to employing competent and tested welders, manufacturers should ensure that engineers, designers and technicians who deal with welding matters have proven relevant competence. This is increasingly becoming a contract requirement: a trend which is expected to accelerate as new European Directives and European/International Standards for welding come into force. EN ISO 14731 “Welding Coordination – Tasks and Responsibilities” requires people with welding related responsibilities to be able to demonstrate that they are competent to carry out those responsibilities. Furthermore, in order to comply with EN ISO 3834, it is necessary also to comply with EN ISO 14731. [3]

EWF and IIW are two major welding organisations in which international expertise in welding and related technologies is assembled. For nearly 30 years, these organisations have been developing guidance documents and technology exchange mechanisms to support companies seeking to adopt best practice in welding. This has been a monumental effort, culminating in the installation of unique and comprehensive training, qualification and certification systems, applied to both people and companies, harmonised on a world-wide basis.

The education and training guidelines have gone through several revisions and new innovative training methodologies have been included. The quality assurance system that is the pinnacle of the international harmonization is constantly being updated to align with standards and regulations.

This paper gives details of the EWF/IIW systems that have been developed and what has been achieved as a result of them. It also outlines the challenges ahead for EWF and how they are being addressed.

2. International harmonisation in welding

The EWF (European Welding Federation) work on the development of harmonised courses which started in 1980, resulted in the implementation of a series of training and qualification ‘guidelines’ and in the definition of examination criteria for welding personnel.

By use of a single syllabus for each level of training course and a harmonized system for examinations management, the same qualification may be awarded in any country.

EWF has further developed the system towards the certification of specific competence of welding personnel and towards the
certification of companies complying with the ISO 3834 requirements. These systems have been implemented in Europe for the last ten years.

An organisation, recognised by the EWF national member society, is appointed as the Authorised National Body (ANB) for the supervision of the system for training, qualification and certification of personnel in each country. Representatives from these ANBs form the operational management within the EWF, and they nominate and approve Lead Assessors and Peer Assessors who ensure conformity of each ANB to agreed Rules.

ANBs are responsible at the national level for:

i) The assessment and monitoring of Approved Training Bodies (ATBs).
ii) The conduct of examinations.
iii) The assessment of applicants for certification.
iv) The issue of Diplomas and Certificates.

There are now 45 that have joined this system with an Authorised National Body, as follows:

Australia, Austria, Belgium, Brazil, Bulgaria, Canada, R.P. China, Croatia, Czech Republic, Denmark, Egypt, Finland, France, Germany, Greece, Hungary, India, Indonesia, Iran, Italy, Japan, Kazakhstan, Macedonia, Netherlands, Nigeria, Norway, Poland, Portugal, Romania, Russia, Serbia, Singapore, Slovakia, Slovenia, South Africa, South Korea, Spain, Sweden, Switzerland, Thailand, Tunisia, Turkey, Ukraine, United Kingdom and USA.

3. International training, qualification and certification system for welding personnel

2.1 The Qualification System and the Personnel Certification System

The EWF has operated a harmonised training and qualification system since 1992, offering courses and qualifications for Welding Engineers, Inspectors, Welders and others. These qualifications form the basis of the widely accepted International Diploma s. Certification of welding personnel was addressed by EWF about 15 years ago. A system was developed and its implementation started in Europe in 1995.

This International Training and Qualification system used in Europe and outside Europe through IIW now comprises the following documents:

- Education, Examination and Qualification Guidelines for:
  - International/European Welding Inspection Personnel – IWIP/EWIP
  - International/European Welder – IW/EW
  - Distance Learning (covering IWE, IWT, IWS, IWIP)
  - International Welded Structures Designer - IWSD

- Rules and Procedures for the implementation of IIW/EWF Guidelines for the Education, Examination and Qualification of Welding Personnel

The existing Guidelines define the course syllabus, indicating for each subject the objectives, scope and expected results, and the minimum teaching duration in hours assigned to them. Access to the harmonised courses is allowed only to those individuals who possess an appropriate agreed level of general technical education, equivalent but different for each country as these are based on national education systems.

Figure 2 represents the structure of the complete international professional Qualification System of Welding Personnel. The relationship with EWF, and the latter’s remaining scope of activities is also shown. It can be seen that an extensive range of welding and welding related courses and qualifications available. These courses are valuable to manufacturers seeking to ensure that all their staff with welding tasks and responsibilities are properly trained and meet the requirements of ISO 14731.

Fig. 2 IIW/EWF Training and Qualification system.

Figures 3 below gives an overview of the structure of the International System for training and qualification of welding personnel which includes courses for engineers, technologists, specialists, practitioners, welders and inspection personnel. These courses can form a basis for lifelong training and professional promotion for personnel working in welding technology.

Fig. 3 IIW/EWF Guidelines Structure.

The EWF/IIW Personnel Certification Scheme provides a simple means by which job capability can be assessed and recognised. It defines the profile of education, knowledge, experience and responsibility required for a range of conventional welding tasks, and provides a professional assessment procedure, see Figure 4 below.

Because Certification is concerned with current competence rather than historical attainment, periodic renewal is required. The
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4. Short term challenges

The Quality Assurance system put in place and coordinated by the Lead Assessors has proven to be reliable and functional. The detailed guidelines and operational procedures assure the high level of knowhow and performance capabilities of the trainees. The reputation of the EWF system is growing worldwide and more countries are joining the system every year. Also, EWF has been a pioneer in implementing a harmonized qualification and certification system for welding professionals.

The IIW and EWF are aware of the importance of the mobility of labour within the world wide community, which requires the best and most comprehensive harmonisation. Therefore a lot of work has been put on the harmonisation of a standard examination system, to ensure that welding personnel trained in the EWF-IIW system are examined in a uniform way, so that those gaining a Diploma in any EWF-IIW Member will have achieved the same minimum standard. This is obtained by the development and implementation of a EWF-IIW Harmonised Examination.

To achieve the above mentioned goal, rules and procedures have been approved, and also an Internet Database Software tool has been developed. The Database Software enables several features, such as: the approval of questions by Teams of International Experts, the translation of the questions into the several Members mother languages, automatic generation of harmonised exams, generation of statistics regarding the questions used on the exams and automatic exams scoring.

Examples of other projects being carried out to improve the system include the design of more flexible courses, structured in modules with new paths, based on skills demonstration through exams and practical tests. Work is also going on regarding the introduction of more distance training modules and new / innovative training tools.

Through European projects such as Virtweld (Virtual Systems for welders training), E-Weld (Distance learning course for welding coordinators) and Weldiction (dictionary of welding terminology), EWF has been innovating in welding training methodologies.

The Virtweld project aimed at supporting the use of virtual equipment for the training of welders. The positive impact of the use of this equipment can be traced to significant reduction in training costs, through savings in the use of consumables and material, as well as in energy consumption. It also proved to be a valuable tool in attracting young people to a welding career.

The need for new welding professionals, together with the retraining of current professionals, is a pressing challenge that the manufacturing industry in Europe faces to ensure its long-term competitiveness. This area has seen a dwindling number of youngsters embracing the profession in the last decade while retraining of professionals has followed the same trend. This can be traced not only to the lack of attractiveness of the welding activity but, more importantly, to the poor appeal that current training methodologies, based on in-room courses, have for prospective students. This trend was described in a Working-Paper by DVS in February 2008, that clearly showed a downturn in the availability of trained welding specialists in Germany, a trend seen in Europe overall, and one that needs to be swiftly addressed.

Focusing on a very successful tool, an interactive CD was developed aiming to overcome the more traditional approaches to...
welding education, and greatly improve the overall welding education environment in the EWF countries, since it will be a more appealing activity to a wider audience, ensuring a steady increase in the number of welding students and improving the conditions for distance welding training.

The developed tool/methodology is considered an essential tool for the improvement of the EWF countries rate of qualified welding personnel, through the use of more effective and user-friendly training methodologies and practices.

In the Weldiction project it was developed a multimedia dictionary covering the most relevant and commonly used welding related terms in twelve languages: English, French, German, Hungarian, Polish, Portuguese, Spanish, Slovakian, Czech, Romanian, Italian and Turkish. The dictionary has also improved the quality of cooperation among the partners' organizations, all of them involved in the training and qualification of welding personnel, as well as facilitating the work force mobility in Europe. By transforming the Welding Dictionary into an App EWF created an unique tool for everyone interested in welding, from the curious learner to the welding professional.

Adding to this EWF has also been involved in the project B-Prof for developing a training methodology and guideline for recognising informal and non-formal competences in adult welders which was carried out in Portuguese, Spanish and Slovenian to test and adjust the methodology.

For raising the attractiveness of the profession for youngsters the EWF members celebrated in a project aimed at the development of a game, Weldplay, which is being used in secondary schools and universities in many of the EWF member countries.

The aim of these improvement projects is to respond to market demands: for example reaching more markets and more remote areas, whilst maintaining the recognised quality of the systems.

Furthermore in order to achieve more 'official' EU recognition for the EWF/IIW qualification system, the EWF is creating partnerships for European Projects with the aim of aligning the EWF qualification system (namely for the welder level) with the EQF, the European Qualification Framework Guidelines regarding the ECVET, European Credit for Vocational Education and Training.

4. Conclusions

Education of young professionals in welding technology and retraining of older workers is in high demand in Europe. Welding and joining technologies are key to a signification proportion of Europe’s manufacturing output.

Welding is a special process that requires careful attention and control in order to avoid problems such as failures and overspends. Thus the need companies have to assure the competence of their welding personnel. This competence is achieved through proper education and training, for example by showing an EWF Qualification and by on-the-job experience.

Control of welding can only be properly exercised through the implementation of special measures before, during and after production, and through the competence of the people involved. Adoption of an ISO 9001 system alone will not necessarily achieve this.

European standards, in some cases backed by EU Directives; International standards; and client specifications are placing increasing emphasis on the proper control of welding and on the competence of welding personnel.

The harmonised international EWF/IIW training, qualification and certification systems described in this paper provide manufacturing companies world-wide and their workforce with a convenient, comprehensive and convincing way of demonstrating compliance with EN ISO 3834 and EN ISO 14731. These systems have achieved considerable maturity and recognition, and are being continuously improved.

Through cooperation projects technologic innovation has been introduced in the education and training methodologies namely by including virtual systems and distance learning modules based on interactive CDs. To overcome the lack of qualified personnel in this area EWF has been active in promoting cooperation projects to facilitate the access to the profession for adult workers and youngsters.

For a worker who wants to acquire skills and to achieve excellence in his profession the recommended goal is to achieve the appropriate EWF/IIW diploma.

5. References

[1] Macroeconomic and sectoral value added by the production and application of joining technology in Germany and Europe
