

## **The International Institute of Welding (IIW), its Potential Positive Influence in the World and some National Models for Technology Innovation**

**(O Instituto Internacional de Soldagem (IIS), sua Influência Potencial Positiva no Mundo e Alguns Modelos Nacionais de Inovação Tecnológica)**

*Chris Smallbone.<sup>1</sup>*

*<sup>1</sup>Executive Director, Welding Technology Institute of Australia, Sydney, Australia  
Immediate Past President, International Institute of Welding (2005-2008)*

### **Abstract:**

*Since its establishment 60 years ago, the International Institute of Welding (IIW) has had numerous successes that have helped the world. In 2006, the IIW introduced a major project entitled “To Improve the Global Quality of Life Through Optimum Use of Welding Technology”. Many of the initiatives being implemented will be of benefit to many countries, particularly with such significant global growth taking place throughout the world. It is estimated that during this next decade, many trillions of US dollars will be spent on infrastructure projects in the energy and processing industry, in this truly global world. Besides the normal fabrication, construction and maintenance work within countries, the additional infrastructure projects will create challenges for welding technology. Such challenges include the fabrication, construction, maintenance, inspection and testing of trillions of components whilst ensuring that they are made efficiently and cost effectively, in an environmentally friendly manner and have high integrity and reliability in service. In most industrialised countries, pressure equipment is aging and plant life is pushed well beyond original design considerations. Much plant is now required to operate at extremely high levels of availability with very limited time available for inspection and maintenance. This is a recipe for disaster. It is predicted that in five years time the world will see an increasing number of failures such as these, possibly resulting in death, injury, environmental damage and lost production. The subsequent economic impact will be enormous. This paper gives an overview of the work of IIW internationally, in various regions of the world and industry sectors utilising welding, the challenges being faced, opportunities available, and probable requirements for the successful introduction and optimum use of welding technology. Successful models used in other countries, particularly for technology diffusion to industry, education and training, improving the image of welding and the use of appropriate technologies will be highlighted. Examples of how the elements of such models could be used in many regions of the world will be given. The involvement of industry and governments across the world in conjunction with the work of IIW and its 53 member countries is critical to the success of such initiatives.*

**Key-words:** *Innovation, business, opportunities*

**Resumo:** *Desde a sua criação 60 anos atrás, o Instituto Internacional de Soldagem (IIS) teve muitos casos de sucesso. Em 2006, o IIS introduziu um grande projeto denominado “Melhorar a Qualidade de Vida Global Através do Uso Otimizado da tecnologia de Soldagem”. Muitas de suas iniciativas beneficiarão vários países. Estima-se que, nesta próxima década, muitos trilhões de dólares serão gastos em projetos de infra-estrutura em indústrias de energia e de processamento. Além de trabalhos de usuais de fabricação, construção e manutenção, os projetos adicionais de infra-estrutura criarão desafios para a tecnologia de soldagem. Estes desafios incluem a fabricação, construção, manutenção inspeção e avaliação de trilhões de componentes de forma eficiente e efetiva, de uma maneira não agressiva ao ambiente e que resulte em elevada integridade e confiabilidade em serviço. Em muitos países industrializados, equipamentos de pressão estão envelhecendo e a vida útil de plantas industriais está sendo levada além do projetado inicialmente. Muitas fábricas estão operando de forma quase ininterrupta com tempo muito limitado para inspeção e manutenção. Isto é uma receita para o desastre. Espera-se que, nos próximos cinco anos, um número crescente de falhas, resultando em morte, ferimentos, danos ao ambiente e perda de produção, ocorrerá através do mundo. Este artigo dá uma visão geral do trabalho do IIS em diferentes regiões do mundo e setores industriais que usam a soldagem, os desafios encontrados, oportunidades disponíveis, oportunidades disponíveis e requisitos prováveis a introdução bem sucedida e o uso otimizado da tecnologia de soldagem. Modelos bem sucedidos, usados em outros países, particularmente para a difusão de tecnologia para a indústria, educação e treinamento, melhoria da imagem da soldagem e uso de tecnologias apropriadas serão destacados. Exemplos de como os elementos destes modelos poderiam ser usados em muitas regiões do mundo serão dados. O envolvimento da indústria e governos através do mundo em conjunto com o trabalho do IIS e seus 53 países membros é crítico para o sucesso destas iniciativas.*

**Palavras-Chave:** *Inovação, negócio, oportunidades*

---

*(Recebido em 05/02/2009; Texto Final em 03/03/2009).*

## 1. THE INTERNATIONAL INSTITUTE OF WELDING (IIW)

The IIW was founded in 1948 by the welding institutes or societies of 13 countries, who felt the need to create it, to make more rapid scientific and technical progress possible on a global basis.

Since then, welding associations in 53 countries make up the members and more and more are indicating interest. There are now 14 members in Western Europe, 14 in Eastern Europe, 5 in the Americas and 20 in Africa/Asia/Oceania.

From the beginning, the IIW set up international groups of specialists to study collectively the scientific phenomena associated with welding and allied processes, their more efficient industrial application and the means of communicating information about them.

It has therefore become the global body in the science and application of joining technology, providing networking and knowledge exchange as part of its mission.

Its mission is to ***“Act as the world-wide network for knowledge exchange of joining technologies to improve the global quality of life”***.

Henry Ford, the great American philanthropist and car maker said *“You can do anything if you have ENTHUSIASM. Enthusiasm is the yeast that makes your hopes rise to the stars. Enthusiasm is the sparkle in your eyes, the swing in your gait, the grip of your hand, the irresistible surge of will and energy to execute your ideas. Enthusiasts are fighters. They have fortitude. They have staying qualities. Enthusiasm is at the bottom of all progress. With it there is accomplishment. Without it there are only alibis.”*

As an enthusiastic leader, IIW can truly make a global contribution.

Welding technology is an enabling technology used across a wide range of industries and applications. These range from micro-joining of medical devices, electronics and photonics (down to 5 microns), to larger scale applications such as bridges, buildings, infrastructure, offshore structures, defence equipment, mining equipment, boilers and pressure vessels, piping, ships, rail and road transport, water and gas pipelines, nuclear, and including components over 1 m thick welded in one pass. All these industries and others exist in all countries to varying degrees, thus creating a significant use of welding technology. Welding and Joining is used widely in the manufacture of most consumer products.

Welding's value to a nation's economy is significant as shown by recent detailed studies in countries such as the USA [1] and Germany [2].

This critical technology encompasses the total life-cycle of welded products/structures including design, manufacture, conformity assessment, inspection and testing, operation, maintenance, repair and decommissioning including recycling and other environmental considerations. Its contribution to the safety and reliability of components in the Energy and Processing Industry is paramount.

## 2. OBJECTIVES OF IIW

IIW has just undertaken a major review of its business plan involving all of its working and administrative units.

Some key IIW objectives, amongst others are:

- Identify, create, develop and transfer world's best practices
- Identify, develop and implement the IIW Education, Training, Qualification and Certification (ETQ&C) Programmes on a global basis
- Promote IIW, its Member Societies and services in various regions of the world to the mutual benefit of all
- Implement the IIW's outcomes
- Provide quality services to IIW members and other organisations

To achieve these objectives in practice, experts from around the world are voluntarily working in 16 Commissions, six Select Committees, two Study Groups and a host of Working Groups or other units on a permanent basis to stimulate and co-ordinate research and technology diffusion, and to diffuse information on welding technology, its application in terms of materials, processes, design and inspection and other associated subjects such as health and safety, education, training, qualification and certification, terminology and documentation.

## 3. STRUCTURE OF THE IIW

### 3.1. Administrative Structure

The policies of IIW are decided by the General Assembly at which are represented all the national member societies. The General Assembly elects the President of IIW and the members of the Board of Directors which directs the affairs of the IIW. The Board of Directors comprises twelve Directors among whom are elected the President, three Vice-Presidents and the Treasurer. Countries currently represented on the Board in 2008/2009 include Australia, Austria, Belgium, China, Germany, India, Japan, Portugal, Singapore, Ukraine and the USA; a good geographical balance between countries.

The day-to-day work is ensured by a four staff member permanent Secretariat based in Paris. Under the responsibility of a Chief Executive, the Secretariat includes a Scientific and Technical Officer, a Standardisation Officer and Secretarial Assistant. The CEO since 2000, Mr Daniel Beaufils retired in January 2008 after eight years of excellent service and has been replaced by Mr André Charbonnier, who is continuing this excellent service.

The Secretariat also maintains contact between IIW and other international bodies such as the International Organisation for Standardisation, United Nations agencies and others.

The Board of Directors has a Technical Management Board (to which over 20 working units report), as well as three other Working Groups; Communications and Marketing, Regional Activities and Liaison with Developing Countries and Standardisation reporting to it.

The IIW, a not-for-profit body, is funded by the member societies paying an annual subscription on a scale designed to reflect, as equitably as possible, the dependence of their country

on welding technology. Such subscriptions are modest and sufficient to pay only a part of the cost of running the Secretariat and associated activities. Further income is derived from the sale of books and other documents, and fees which are collected from each Annual Assembly participant.

By far the greatest contribution from member societies comes in the form of the input of their delegates to the working programmes of the Commissions. The cost of delegates attendance at

Annual Assemblies and any intermediate meetings of Commissions and Sub-Commissions are borne by their Member Societies or the delegates' employers.

Throughout the life of IIW, the scope of its technical programme has been continually expanded to include new technologies. Such have included more recently, the joining of plastics and composites, the capabilities of computers in design, process control, inspection and information handling, welding in a variety of environments and under remote control, new concerns for the health and safety of those working in industry and the education, training, qualification and certification of personnel and companies

The Institute, in July 2007, finalised its new Business Plan involving all administrative and working units to ensure ownership by all participants over the 2007-2012 period.

### 3.2. International Authorisation Board (IAB)

An important innovation of the IIW was the formal establishment in 1999 of an international programme for the qualification of personnel involved in welding operations. Through the IAB, this scheme allows the IIW Authorised National Bodies (ANBs) in member countries to deliver, under the control of the IIW, Diplomas of International Welding Engineers (IWE), Technologists (IWT), Specialists (IWS), Practitioners (IWP), Inspectors (IWI) and Welders, amongst others. The Diploma holders for IWE, IWT and IWS are de facto recognised as able to be Responsible Welding Coordinators according to the ISO Standard ISO 14731 "Welding coordination; Tasks and responsibilities".

Thirty-five IIW members actively participate in the IAB and through their ANBs, over 30,000 IIW Diplomas have been issued since the programmes started in 2000. The Instituto de Soldadura e Qualidade in Portugal provides the Secretariat for the IAB and its two working groups, A "Education, Training & Qualification" and B "Implementation & Authorisation".

With the ever-growing global use of the ISO 3834 "Quality requirements for fusion welding of metallic materials" and ISO 14731 "Welding coordination – Tasks and responsibilities" standards, more and more countries are using the IIW International Programmes.

Since January 2008, IIW through the IAB, has also introduced programmes for the certification of personnel and certification of companies to ISO 3834.

### 3.3. National Delegations

People can be appointed to be members of their national

delegation. The appointment process varies from one country to another but generally the main criteria are:

- to be known by the relevant national authority responsible for the appointment of the country's delegation;
- to be an expert in a subject dealt with by an IIW Commission or other Working or Administrative Unit;
- to have the motivation and energy to participate in the co-operative work of the unit which may meet not only at the Annual Assembly, but more frequently in order to maintain progress (often in Paris in January each year);
- to have an interest in working with people of other nationalities whose basic assumptions and habits of thought may well be quite unfamiliar.

For those committed to co-operation, there are many opportunities to contribute to, and learn of, work which will be valuable to them professionally and to their employers, to make the acquaintance of fellow experts from other countries, to gain, through personal contacts and technical documents, advance knowledge of impending developments and, in some cases, to influence the content of international welding standards.

## 4. SOME ACHIEVEMENTS OF IIW

### 4.1 Technical Management Board

The groups of experts in the Technical Commissions and other units under the Technical Management Board have achieved many outputs useful to industry, both nationally and globally:

#### a) Technical Papers

Each year about 400 papers emanate from the IIW working units of which about 60 are published in the IIW journal "Welding in the World". A plan of action has been developed in order to meet the requirements of the Science Citation Index which includes the implementation of a peer review procedure for the research papers and IIW Database.

In addition, a total of some 100 books dealing with recommended practices or the results of international enquiries have been published mainly in two or more languages.

#### b) Terms and IIW Database

IIW has compiled a number of works of reference such as the Multilingual Collection of Terms for Welding and Allied Processes (9 volumes mostly containing 16 or more languages), the International Welding Thesaurus developed over 30 years in conjunction with the TWI bibliographic database Weldasearch, the Index of Welding Standards and a collection of radiographs illustrating weld defects. More recently the IIW Database, referencing all IIW technical documents since 1950, has been made available online through the IIW website.

All these works were approved for publication by international groups of experts and so are authoritative.

IIW's virtual library constitutes one of the world's largest online sources of welding information available today. IIW Members can consult and share technical documents, white papers, publications and articles through a database of around

15,000 documents, of which more than 4,300 may be downloaded from the IIW web site <http://www.iiw-iis.org>. Bibliographic reference to documents can be searched by all visitors to the website, and hard copies acquired through the IIW Secretariat.

#### c) *ISO Support*

With regard to the objective of formulating international standards, the working units of the IIW have supplied the technical basis of the great majority of welding standards issued by the ISO over the past 35 years. Members of these working units and their employers have therefore had a major influence over the content of such standards. Since 1989 the IIW has been authorised by ISO to prepare the final texts of international welding standards as an international standardising organisation. This work is coordinated by the standardisation staff within the IIW Secretariat and an increasing number of ISO Technical Reports are being produced.

#### d) *Promotion of National Industry*

IIW has also been successful in promoting the organisation of national welding associations. Such associations have been formed with a view to their becoming members of IIW, thus enabling experts from their respective countries to participate in IIW activities. The IIW has taken steps to increase the promotion of membership in developing countries and economies in transition, which could benefit greatly from the collective knowledge of the IIW in many areas, in particular welding education and training, appropriate welding science, technology and practice, and the health and safety of welding personnel. Before becoming full members, countries can join as Associate Members.

Within the same country more than one organisation can group together normally under a national council for IIW.

IIW has recently amended its membership rules to make it easier for small developing countries to become members. Up to three countries with common geographical boundaries and less than 1m tonnes of steel consumed between them can group together as one member.

#### e) *Annual Assemblies*

IIW Annual Assemblies have been taking place since 1948 and take place on the invitation of one or other of the member countries and last for a week. Three days are normally devoted to parallel sessions of the Commissions and other working units. In addition, two days are normally devoted to an international Conference on a specified theme. The papers presented at this Conference are normally published in bound volumes and/or CD format available for purchase, and as a special issue of the IIW journal "Welding in the World".

Generally, over 40 countries are represented by about 450 delegates at Annual Assemblies together with about 200 accompanying persons. Attendance at meetings of IIW working units is confined to those who have been appointed by their national delegation whereas the International Conference is open to any person.

Recent public event themes including the one for 2009 are:

- 2004 "Technical Trends and Future Perspectives of Welding Technology for Transportation, Land, Sea, Air and Space", Osaka, Japan
- 2005 "Benefits of New Methods and Trends in Welding to Economy, Productivity and Quality" Prague, Czech Republic
- 2006 "11<sup>th</sup> International Symposium on Tubular Structures", Quebec, Canada.
- 2007 "Welding & Materials: Technical, economic and ecological aspects", Dubrovnik, Croatia
- 2008 "Safety and Reliability of Welded Components in Energy and Processing Industry", Graz, Austria.
- 2009 "Advances in Welding and Allied Technologies", Singapore

Other specialist public events and seminars are usually held in association with the Annual Assembly.

The IIW will continue the programmes of its various working units, particularly on the occasion of forthcoming Annual Assemblies, which will be held as follows:

- 2009 Singapore
- 2011 Mumbai, India
- 2010 Kiev, Ukraine
- 2012 USA (venue to be finalised)
- 2013 Essen, Germany

#### 4.2. *Regional Activities and Liaison with Developing Countries*

During the 1980s, discussions took place within IIW on how the benefits of IIW could be promulgated to countries in the different regions of the world. It was felt that the three key areas by which IIW could assist regions, developing countries and economies in transition to improve the quality of life of all people were through implementing:

- Appropriate welding technology
- Education, training, qualification and certification
- Occupational Health & Safety (OH&S)

To start implementing this strategy, it was agreed to hold Regional (now called International) Congresses with the following specific objectives:

- To expose delegates from industry in the host countries in the region, to the work of IIW
- To identify the needs of the surrounding countries in the region and produce IIW supported programmes to help meet those needs particularly through the efforts of the host country
- To have organisations such as the United Nations Industrial Development Organization (UNIDO), International Atomic Energy Agency (IAEA) and the European Union (EU) formally involved in the Congress and subsequent programmes
- To have authors from the less developed, surrounding countries presenting papers
- To form regional Commissions of the IIW using representatives of the regional countries that could then provide input to the main IIW Commissions.

These Congresses have become very popular and successful.

The IIW's first International Congress was held in Australia in 1988, followed by Brazil (1992), New Zealand (1996), South



Africa (1997), Iran (1998), Australia (2000), Singapore (2002), Iran (2003), Egypt (2004), India, Israel (2005), South Africa, Romania and Thailand in 2006, Australia in 2007 and India, Brazil and China in 2008. Further International Congresses already planned include: 2009 Nigeria, Slovakia and Iran; 2010 Israel, Thailand, Tunisia, Mexico, Malaysia, Indonesia and Vietnam; 2014 India. A major success of these Congresses has been to assist technology development and diffusion in regions sometimes far removed from the locations of the majority of Annual Assemblies and to encourage IIW membership in developing countries in these regions.

An important approach since 1993 has been to have a more systematic approach to regional activities with the compilation of a strategic business plan for the Working Group with the Goal "To promote IIW and its member societies to the countries in the various regions of the world to the mutual benefit of all", and four key objectives:

- To promote the holding of IIW supported events throughout the Regions of the World
- To introduce the IIW WeldCare Programme for take-up by Developing Countries and Economies in Transition
- To continually promote and market IIW in different Regions of the World
- To harmonise IIW's efforts with other organisations' efforts in each Region

Over 20 detailed strategies support this Goal and Objectives.

## **5. IIW STRATEGIC PLAN AND BUSINESS PLAN (2007 – 2012)**

McKinsey Quarterly Web Exclusive 2006 highlights some important global trends to watch for [3]:

- Centres of economic activity will shift profoundly, not just globally but also regionally
- Shifts within regions will be even more dramatic
- Today Asia (excluding Japan) accounts for 13 percent of the world's GDP, while Western Europe accounts for more than 30 percent. Within 20 years the two will converge

### *5.1. Objective*

The IIW, at its Annual Assembly in Prague in July 2005, agreed to a new approach on updating its Strategic Plan and Business Plan for the next five years.

In today's world, no country or organisation can remain in isolation with issues now becoming truly global e.g. the ozone layer problem, Chernobyl, trade, travel, IT, climate change, etc.

Most people in the world simply wish for a decent job and roof over their heads, sufficient food, health and security for their families and a decent education for their children, and an environment in which all forms of life can exist in harmony.

Part of the vision of IIW is to have an influence in the promotion of welding technology in all countries of the world. In particular, IIW wishes to be able to grow to an optimum size whereby the necessary identified services can be provided to its members.

There are over 200 countries in the world, however, and all use welding and joining to varying degrees; 53 of these countries are members of IIW probably representing over 80% of the developed world.

To achieve this part of its vision, IIW is now at a stage in its development where it is playing a leading role as a facilitator, through its member societies, to meet the needs of many non-member countries and at the same time improve its own image and influence on the global stage.

Now, particularly with the shifting of global industrial and population growth, the IIW is encouraging these new centres as well as those of the developing countries, to become more involved in IIW.

The main needs of many developing countries and those with economies in transition are arguably, in education, training, qualification, certification, health and safety as well as the introduction of appropriate technologies to be customized for use in their industries.

### *5.2. IIW Project "To Improve the Global Quality of Life through the Optimum Use of Welding Technology"*

If one considers all the attributes of an organisation such as IIW, a key challenge is how to utilise these attributes to achieve the above Project objective. This Project, approved by the IIW Board of Directors in July 2005, can dovetail many of the IIW activities (including those of its member societies) that are taking place to everybody's mutual benefit. A few of which could be important to different world regions, are discussed below.

#### *5.2.1. IIW Regional Activities and the IIW WeldCare Programme*

In many developing countries numerous geo-political and socio-economic problems hold back their sustainable development in a sustainable environment. Also their science and technology attributes have struggled to develop for a myriad of reasons.

This programme was initiated in 1994 when IIW President Raul Timmerman, Vice President Chris Smallbone and Head of the IIW Technical Secretariat, John Hicks approached UNIDO representatives for support for such a programme [4]. The model was based on the South African Institute of Welding (SAIW) led by Chris Smallbone, which grew from a part-time secretary in 1977 to a full time staff of 49 in 1989, based in a fully owned 3500 sq m specific purpose building [5]. The concept of having educational support centre networks and technology support centre networks grew from this model [6]. With 7 full-time technical consultants, 14 full-time lecturers and instructors, it operated throughout Southern Africa uplifting the quality of life of millions of people. From 1980 to 1989 it introduced more types and levels of world class personnel qualification and certification programmes than any single organization in the world has ever done. These still operate successfully today and, where applicable, have been converted to international programmes. UNIDO was quite enthusiastic to support the

programme for the rest of Africa. Unfortunately the UNIDO support fell away due to personnel changes in UNIDO but has recently been renewed.

Some success did arise however, through the International Atomic Energy Agency (IAEA). Initiated by SAIW in 1992, since 1994 the IAEA has supported parallel NDT training and qualification for the whole of Africa, conducted at the SAIW.

Over the past 20 years, many examples can be given of projects where IIW member countries have assisted both member and non-member countries to improve their welding technology and hence quality of life.

Consider the following examples amongst many others:

- |                              |                                 |
|------------------------------|---------------------------------|
| ◆ Germany-China              | ◆ France-Thailand               |
| ◆ UK-Malaysia                | ◆ USA-Trinidad and Tobago       |
| ◆ Japan-Vietnam              | ◆ Portugal-Angola               |
| ◆ Japan-Egypt (Africa)       | ◆ Austria-Indonesia             |
| ◆ South Africa-Africa (IAEA) | ◆ Holland & Canada-South Africa |
| ◆ Germany –Vietnam           | ◆ Australia – South Africa      |
| ◆ USA – Nigeria              | ◆ Germany – Indonesia           |

The main emphasis on all the above examples was on education and training and appropriate technologies.

IIW is actively cooperating with aid agencies to expand these types of projects through its IIW Weldcare Programme. Discussions are taking place with agencies such as IAEA and UNIDO on welding technology training for different levels and types of personnel throughout Africa. Such programmes were first recommended back in 1992 with a joint team effort by WTIA, ESKOM and the SA Atomic Energy Agency (AEA) initiating IAEA NDT training still being supported today [7]. This was based on the successful IAEA South American model. Such programmes could also be implemented in some of the regions of the world currently being organized by IIW, e.g. Western Africa, South East Asia, and Gulf Region.

IIW has tremendous strength in its member countries. Its member societies have resources to assist in establishing within a particular country or region:

- An organization that would be responsible for the promotion of welding technology and related disciplines;
- The required welding education and training infrastructures;
- The appropriate technologies to assist the different industries being established and able to be self sustaining in a sustainable environment.

A proper business plan for each country would need to be devised however, financially supported and implemented with appropriate milestones and key performance indicators. IIW is assisting countries with a model business plan and strategic plan.

Depending upon the geographic size of the country, its industrial size and distribution, a practical action plan to suit the

specific needs of the country should be possible.

### 5.2.2. Education, Training, Qualification and Certification – IIW Educational Support Centres Networks

Culture is “A way of life or life style summarised in a system of particular values and attitudes which result in characteristic actions and customs”. There are three key cultures that help make a country, company or individual successful.

A skills culture is a national way of life which is characterised by:

- support of, and value placed on, a willingness to learn
- respect for people who acquire skills
- tangible rewards for individuals who acquire skills

This means that people at all levels and in all disciplines in organisations will have a willingness to adapt or learn new skills. They will also be seen to deliver excellent work results. Organisations will be seen to promote skills development and will be highly productive and competitive.

All of the above will lead to a thriving national economy since a culture of skills development is encouraged nationally.

A quality culture where companies with the correct culture in quality automatically:

- introduce quality management systems
- provide service quality
- improve performance and productivity
- cut costs and improve profits
- give clients confidence in the reliability of products
- give clients confidence that the orders will be right first time on time

A productivity culture is about the ability that a system [be it an individual, a department, a business or the economy] has, to use all the resources at its disposal in a collective sense to provide products and services which are useful to the end user.

Productivity improvement is the improvement of that ability.

A productive culture is where everybody and every effort contributes to improving and building up themselves, the economy and the nation.

Through IIW Commission XIV ‘Education and Training’ as well as the member countries in the IIW IAB, all 53 IIW members are involved in education, training, qualification and certification of personnel and many with the certification of companies – all contributing to a skills culture in the welding industry.

This has enabled IIW to establish an international network of educational/training support centres into which any non-member country can dovetail. A similar network could become a greater reality in any country or region with the national IIW ANB (s) coordinating it. Excellent working national models exist in countries such as Germany and Australia with the German model being outstanding. South East Europe is currently introducing a model between six to nine countries.

Training is a most powerful way for national improvement. With the increase in global trade, the need for product conformity assessment and the ever increasing number of product or application standards specifying ISO 3834 and ISO

14731, there is growing demand for international approaches to personnel qualification and certification, as well as certification of companies.

In Prague, in July 2005, the IIW Board of Directors resolved to introduce IIW certification programmes already introduced by the European Welding Federation, amongst others.

These include:

- Certification of International Welding Engineers, Technologists, Specialists
- Certification of companies to ISO 3834 Quality requirements of fusion welding of metallic materials.
- Certification of companies on Occupational Health and Safety Management.
- Certification of companies on Environmental Management.

The first two above were launched in Croatia at the 2007 IIW Annual Assembly and the latter two should follow fairly quickly.

The introduction of an IIW certification programme for welding inspection personnel is currently under discussion.

### 5.2.3. IIW Technology Support Centres Networks

A key IIW strategy is the promotion of the concept of innovation through technology diffusion which can be defined as:

- Identifying and analysing the needs of industry in a country or company
- Sourcing solutions to meet these needs
- Disseminating the technology and information into companies, particularly SMEs and micro-enterprises
- Adopting, adapting and implementing by technology receptors of new technology/information
- Improving performance of the companies and measuring the value of improvements
- Providing feedback for further national or company improvements at each stage of the technology diffusion process

In any country, at least 97-98% of information/knowledge required is readily available from other countries' sources; technology diffusion is more important to many countries than conducting research.

IIW member societies with a well developed infrastructure can easily access and utilise the outcomes of the IIW Technical Commissions and working units to improve innovation in their countries. Developing countries and those with economies in transition may need to utilise a different approach or concept to suit their particular condition.

IIW has investigated and developed other models for different types of countries.

It has held a number of Technology Innovation workshops in IIW member countries including India, Bulgaria, Romania, Serbia and South Africa.

In Australia, the WTIA has established a very successful model entitled 'OzWeld Technology Support Centres (TSCs) Network' [8] which has further expanded to the "SMART TechNet" project. The South East European countries including Romania, Bulgaria, Croatia, Macedonia, Serbia, Bosnia, Turkey,

Greece and Montenegro are now working together to implement a similar TSCs network between their countries. The first day of the three-day IIW International Congress for the South East European countries from the 26<sup>th</sup>-28<sup>th</sup> May 2006 in Timisoara, Romania was dedicated to a Technology Innovation workshop discussing the implementation of such a model.

UNIDO, IAEA, the EU and the Department for International Development (DFID) in the UK agreed to give presentations and work together with IIW member societies to investigate the correct way forward for the region.

In January 2007, a two-day workshop was held in Belgrade to move the concept further along and was followed by a further workshop in Athens in January 2008.

A key outcome could then be IIW member societies working with the aid agencies mentioned to facilitate projects in a variety of regions around the world e.g. Southern Africa, South East Asia, West Africa.

A combination of the models in 5.2.2 and 5.2.3 is presently being promoted as an ideal model [9]. This could also be used nationally in many countries such as India, China, Brazil and Indonesia.

### 5.2.4. Improving the Image of Welding

A common complaint amongst IIW member societies is the poor image of welding, with the general public, governments and general industry, but particularly with young people, leading to their lack of interest in careers in the welding industry. Some countries such as the USA and Germany have initiated national campaigns and even countries such as Japan, which has had an excellent record in welding technology, are also facing problems in this area.

The IIW is now studying how an international approach through IIW and its member societies can be implemented. When one considers how modern society depends so much on welding technology, it is quite amazing that one still has to continually 'sell' the technology. The value of welding and its contribution to daily life are not appreciated by many sectors of society.

How could people survive without services such as transport and water, products such as computers, mobile phones, artificial hearts, bionic ear implants, etc, etc, etc? Where do the global and individual benefits end? Whether a high pressure gas pipeline extending thousands of miles across Australia or a pipe supplying water to a village in Africa, welding technology makes a huge positive impact on the global quality of life. Its value to a nation's economy is both significant and critical as shown by studies in countries such as the USA and Germany.

16 strategies on improving the image of welding have been implemented in the sections of the IIW Business Plan involving the IIW Board of Directors, International Authorisation Board (IAB), Working Group Regional Activities and Commission XIV.

### 5.2.5. IIW White Paper or White Book

One important strategy that is part of the project is for IIW to



compile a “White Paper” or “White Book” entitled “To Improve the Global Quality of Life Through the Optimum use of Welding Technology”. Such a document is to be used on an international basis and aimed at decision makers in Governments, industry, research and development, academia, education and training, amongst others, to assist them in their welding related areas of interest or influence.

The IIW has formed a White Paper Task Group consisting of 12 prominent members of the global world of welding and more than 40 international experts are contributing to the document.

For example, it could:

- Influence governments and industry on the R&D needs, magnitude and types of research funding to be made available
- Improve the image of welding and its importance to both the national, regional and global economies
- Guide industry on future types and numbers of personnel requirements
- Provide technological developments including “hot topics” to improve the global quality of life
- Raise the national and international profile of IIW and its member societies.

The title of the “White Paper” is linked to the title of the IIW Project “To Improve the Global Quality of Life Through the Optimum Use of Welding Technology”.

It will have the following five objectives amongst others:

- To identify the challenges for welding and joining technology in the global arena
- To recommend the implementation of strategies to find solutions to meet these challenges
- To agree on solutions for the next 20 years
- To promote the implementation of identified solutions on a national, regional and international basis through greater collaboration, shared knowledge and partnerships.
- To improve overall global quality of life i.e. health, safety, food, water, fair trade, environment, education opportunities.

## 6. POTENTIAL REGIONS OF COOPERATION

The welding industries in all world regions are facing some exciting challenges over this next decade particularly due to the forecast in global growth and it being evident that vast amounts will be spent on infrastructure projects alone, with enormous economic growth taking place in countries such as China, India and neighbouring countries.

Industry sectors involved in such projects, and all involve welding technology, include road, rail, water, transport, power generation, petro/chemical, nuclear, pipelines, oil and gas offshore amongst others; all related to energy and processing.

Such projects also enable countries to improve the quality of life of their people whilst at the same time protecting the environment both nationally and internationally. This is so important since “no man is an island” as has been shown by disasters such as the failure at the Chernobyl Nuclear Power Plant in the Ukraine or lately the problem of climate change.

The geo-political and socio-economic challenges of

countries have been well documented. How does an organisation such as IIW and its member countries try to assist countries further to improve their quality of life? Examples have been given previously [10-21].

The variety and magnitude of the challenges facing countries as well as the resources to meet the challenges probably vary from country to country.

In terms of the welding industries to be involved in infrastructural projects, as well as the normal fabrication, construction and maintenance work that happens on a daily basis, the IIW is confident that there are many areas in which the national welding associations can work together with IIW for the common good.

The first step in finding a solution would be to continue to promote greater regional cooperation and greater involvement in IIW by regional country representatives.

International organisations such as UNIDO, EU, DFID (UK) and IAEA could channel projects through IIW, these countries and the regions.

The IIW Member Societies in the different world regions are prime players in welding education, training and technology transfer, and with adequate resources, could all play a bigger role in the regions.

Since 1970, major drives have been made to establish, within the countries, training schemes leading to qualification and certification of personnel on a national, regional and now on an international basis through the IIW.

South East Europe, Southern Africa, South East Asia, Western Africa and Australasia are examples of regions that have established training facilities and IIW ANBs which could play a very successful coordinating role in the establishment and delivery of various training schemes to meet the manpower requirements of the industry of the different regions.

Two important approaches could be the establishment of national or regional Educational Support Centres Networks and national or regional Technology Support Centres Networks throughout the world. Numerous outcomes could result giving tremendous benefits to the people and companies.

## 7. CONCLUSIONS AND RECOMMENDATIONS

The IIW is probably now in its strongest position in its history with an excellent team effort during the past eight years, culminating in a well balanced organisation with sound and enthusiastic leadership from its Board of Directors, excellent teams of world experts comprising the working units, a competent hardworking Secretariat, a range of relevant outcomes including products and services of value to its members, with increasing interest by more countries in becoming members. It has strong regional members which, with the support of IIW, industry, governments and aid agencies can deliver immense benefits to the regions throughout the world.

IIW’s colleagues in all countries can contribute to these objectives, in the following ways, amongst others:

- i) Actively contribute to the IIW project ‘Improving the global quality of life through the optimum use of Welding Technology’.



- ii) Actively support the IIW initiative to improve the image of welding.
- iii) Nominate more delegates to participate in meetings of the IIW technical Commissions and working units (see Appendix), which would be to the benefit of the individual, their companies and thus the country as a whole, as well as contributing to global welding technology development.
- iv) Consider linking into and expanding the IIW technology diffusion projects including the establishment of country and regional Technology Support Centres Networks.
- v) Consider establishing country and regional Educational Support Centres Networks.
- vi) Contribute to the continual development, promotion and use of the IIW White Paper – WhiP “Improving Quality of Life Through Optimum Use and Innovation of Welding and Joining Technologies”

IIW looks forward to welcoming participants from around the world to future Annual Assemblies and to working with all people interested in improving the quality of life in the world.

We believe that, with the three attributes of ENTHUSIASM, PERSISTENCE and COOPERATION, we can all work together in an excellent team effort to improve the quality of life of people globally.

## 8. REFERENCES

- [1] AWS. Welding-Related Expenditure, Investments, and Productivity Measurement in U.S. Manufacturing, Construction and Mining Industries, May 2002
- [2] Middeldorf, K.; Herold, H., Von Hofe, D. Trends in Joining – Value added by Welding. IIW Conference, Prague July 2005
- [3] McKinsey, Quarterly Web Exclusive. 2006
- [4] Hicks, Communications and meeting between IIW and UNIDO representatives. Raul Timmerman, Chris Smallbone, John Hicks, Vienna, January 1994
- [5] SAIW, A Quantum Leap 40 years and on. FWP Journal March 1988 Vol 28 No. 3 pp 7-35.
- [6] Smallbone, C. The Challenges in Education and Training for Third World Countries Parts 1 and 2. FWP Materials Engineering Journal, vol. 32, no. 4, 1992, pp25-27 & vol. 32, no. 5, 1992, pp 11-16
- [7] WTIA, Communications between WTIA, ESKOM, AEC and IAEA. 1992-1993
- [8] Smallbone, C. The OzWeld Technology Support Centres Network: A Unique Model for Technology Innovation by Industry. Trends in Welding Research Conference, Georgia, USA. 2002
- [9] Smallbone, C. National Model for Optimum Innovation Through Welding and Joining Technology. WTIA 53<sup>rd</sup> Annual Conference, Darwin, Australia, October 2005
- [10] Smallbone, C. A vision for a cooperative team effort in welding and pressure equipment technology in the Asian Pacific region, India 2001
- [11] Smallbone, C. A vision for a cooperative team effort in welding and pressure equipment technology in the Asian Pacific region, IIW Asian Pacific International Congress, Singapore, October 2002
- [12] Smallbone, C. Competent personnel and technology – The real solution to improved performance, IIW Asian Pacific International Congress, Singapore, October 2002
- [13] Smallbone, C. The opportunities for the Indian welding industry through optimum technology diffusion, International Welding Symposium on Emerging Trends in Welding, Hyderabad, India, February 2003
- [14] Smallbone, C. Commercialisation and Innovation; A Panacea or Simply Buzz Words? 2nd New Zealand Metals Industry Conference, Auckland, NZ, 11-12 November 2004
- [15] Smallbone, C. Improving the Global Quality of Life Through the Optimum Use of Pressure Equipment Technology, Operating Pressure Equipment Conference, Chennai, India, 7-9 February 2006
- [16] Smallbone, C. To Improve The Quality Of Life In South East Asia Through Optimum Use Of Welding Technology, IIW International Congress, Bangkok, Thailand, 21 November 2006
- [17] Smallbone, C. Some National Models for Technology Innovation, IIW South East Europe International Congress, Timisoara, Romania, May 2006
- [18] Smallbone, C. A Vision to Improve the Quality of Life in Africa, IIW Southern Africa International Congress, Cape Town, South Africa, March 2006
- [19] Smallbone, C. To Improve the Quality of Life in the Asian Pacific Region Through Optimum Use of Welding Technology. Jaeger Lecture. 5<sup>th</sup> Asian Pacific IIW International Congress, Australia, March 2007
- [20] Smallbone, C. Global Improvement of Life through Welding, FABTECH International and AWS Welding Show, Chicago, USA, November 2007
- [21] Smallbone, C. The Challenges for India in Welding and Joining over the next Decade, IIW International Congress, Chennai, India, January 2008

## APPENDIX – IIW WORKING UNITS

### OVERVIEW OF IIW COMMISSIONS

Commission I

**Brazing, Soldering, Thermal cutting and flame processes**

**Chairman:** Prof Veli Kujanää, Finland

Sub-Commissions and Working Groups

SC IA Brazing and Diffusion Bonding (Warren Miglietti, USA).

SC IC Thermal Spraying and Surfacing

SC IE Thermal Cutting and Related Processes (David Howse, UK)

LCWG Laser Cutting Working Group (Flemming Olsen, Denmark).



**Commission II**

**Arc Welding and Filler Metals**

**Chairman:** Vincent van der Mee, The Netherlands

**Sub-Commission and Working Groups**

- SC II-A Metallurgy
- SC II-C Testing and Measurement of Welds
- SC II-E Standardisation

**Technical topics considered**

- Diffusible hydrogen measurement
- Weld metal cracking
- Chemical reactions
- Ferrite in weld metal
- Constitution of welds
- Hot cracking and micro fissuring
- High strength steels
- Corrosion
- Welding fume standardisation

**Commission III**

**Resistance welding, solid state welding and allied joining processes**

**Chairman:** Dr Miro Uran, Slovenia

**Sub-Commission and Working Groups**

- SC III-A Resistance welding and allied processes
- SC III-B Friction based processes
- WG-A1 Testing of welds
- WG-B1 Standardization on Friction Stir Welding (FSW)
- WG-A2 Monitoring and control
- WG-B2 Mechanical properties database
- WG-S Standardization
- WG-B3 Modelling for FSW

**Technical topics considered**

- One-day Workshop for automotive applications
- Start to develop a similarity rule for TSS of spot welds
- CD voting on FSW-Aluminium (Part 1 ~ Part 5)
- Developing mechanical properties database for FSW
- Round robin/bench-marking program on FSW
- Quality managements of spot welds



**Commission IV**

**Power Beam Processes**

**Chairman:** Ernest D. Levert, USA

- Technical topics considered
- Electron beam welding
- Laser welding and drilling
- Yag laser welding of aluminum die castings
- Electron beam free form fabrication technology

Application of laser welding to stainless steel light rail vehicle  
Co2 laser-GMA hybrid welded high strength steel joints

**Commission V**

**Quality control and quality assurance of welded products**

**Chairman:** Dr Philippe Benoist, France

**Sub-Commission and Working Groups**

- SC VA Radiography-based Weld Inspection Topics (Uwe

Ewert, Germany)

SC VC Ultrasonically based Weld Inspection Topics (Eric Sjerve, Canada)

SC VE Weld Inspection based on Electrical, Magnetic, and Optical Methods (Gerd Dobmann, Germany)

SC VF Weld Defects and their Significance (John Zirnheld, Canada)



**Commission VI**

**Terminology**

**Chairman:** Dietmar Rippegather, Germany  
Sub-Commission and Working Groups  
WG 1 IIW-Thesaurus (Sheila Thomas, UK)

**Technical topics considered**

- Check of FSW standard
- Creation of a list of old welding terminology documents

- Finalisation of thermal cutting dictionary
- Implementation of other languages to dictionaries
- Revision of laser welding terms document
- Digitising of other welding terminology lists



**Commission VIII**

**Health, Safety and Environment**

**Chairman:** Luca Costa, Italy

- Terms of reference
- To regularly review the general trends and the implementation of the activities within the field of a sustainable environment, with regard to joining fabrication
- To introduce the relevant issues concerning

- the sustainable environment in IIW
- To encourage all the IIW Working Units to contribute to a sustainable environment
- To share information on any national rule
- To produce documents helping to apply ISO 14001 standard to welding, joining and cutting processes

**Technical topics considered**

- Welding fumes
- Fume data sheets
- Effects of Cr and Mn on health
- Ergonomics of welding activities
- Physical safety of welders



**Commission IX**

**Behaviour of metals subjected to welding**

**Chairman:** Thomas Boellinghaus, Germany

**Sub-Commission and Working Groups**

- SC IXC Creep and heat resistant welds (John Hald, Denmark)
- SC IXH Welding of stainless steels, nickel-based alloys and heat resisting steels (Leif Karlsson, Sweden)
- SC IXL Low alloyed steel welds (Toshi Koseki, Japan)

SC IXNF Weldability of non ferrous materials (Jorge dos Santos, Germany)

WG Mathematical modelling of weld phenomena (Horst Cerjak, Austria)

**Technical topics considered**

Low alloyed steel welds  
Corrosion resistance of welds  
Non-ferrous metals welds  
High alloyed steel welds  
Creep and heat resistant welds



Commission X

**Structural performances of welded joint - Fracture avoidance**

**Chairman:** Mustafa Kocak, Germany  
Sub-Commission and Working Groups  
SC XE Significance of defects with regard to brittle fracture  
SC XF Significance of strength mismatch in welds  
WGG The selection of steel and statistical

approaches

WG X/XV Residual stress and distortion prediction and control



Commission XI

**Pressure vessels, boilers and pipelines**

**Chairman:** Martin Prager, USA  
Sub-Commission and Working Groups  
SC XIE Transmission pipelines  
WG Post-weld mechanical and heat treatments  
WG Repair welding  
WG Codes analysing

WG Requirements for avoidance of cracking in pressure vessels

**Technical topics considered**

Joining and Performance of Materials with Dissimilar Properties - A Joint symposium with Commissions V and X, including topics ranging from over-matching and under-matching with regard to strength or creep resistance, FAD issues, inspection challenges, choice of consumables, selection of preheat and heat treat treatment conditions etc.

Welding, acceptance and expectations for materials beyond X70

Data collection to permit correlation and prediction of fracture toughness.

Creep and Heat Resistant Welds

Hydrogen Infrastructure issues

Fatigue of Weldments

Derating Welds of Advanced Alloys in Creep service.

Compendium of Repair Welding Procedures



Commission XII

**Arc welding processes and production systems**

**Chairman:** Prof William Lucas, UK  
Sub-Commission and Working Groups  
Sensors and control  
Underwater engineering  
Production systems and application  
Arc welding processes  
Quality and safety in welding

**Technical topics considered**

Recent advances in TIG welding processes  
Modelling of arc and weld pool behaviour  
Metal transfer modes in tandem MIG welding  
Underwater hyperbaric welding  
Sensors for control and monitoring weld quality  
Classification of metal transfer modes in MIG welding



Commission XIII

**Fatigue of welded components and structures**

**Chairman:** Prof Gary Marquis, Finland  
Sub-Commission and Working Groups  
WG1 Fatigue testing and evaluation of data for design  
WG4 The influence of weld defects in fatigue-loaded structures  
WG2 Techniques for improving the fatigue

strength of welded joints

WG5 Repair of fatigue-loaded structures

WG3 Hot-spot stress method in fatigue analysis of welded Components

JWG XIII/XV Fatigue design rules

Joint Commission X, XIII and XV Working Group Residual Stress and Distortion Prediction in Welded Structures (RSDP)

**Technical topics considered**

Fatigue of welded joints and structures Fatigue life improvement methods

Fatigue design and assessment Residual stress

Structural and notch stress analysis Weld quality and fatigue

Fatigue sensors Fatigue testing and statistical evaluation of fatigue data



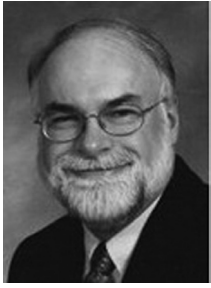
Commission XIV

**Education and training**

**Chairman:** Ulrich Hadrian, Switzerland  
**Term of Reference**  
To promote how to better teach welding at all levels. The work of Commission XIV dovetails in with that of the IIW International Authorisation Board (IAB). Commission XIV provides the link between all the other IIW Working Units

(Commissions, Study Groups and Select Committees) and the IAB.





Commission XV  
**Design, Analysis and fabrication of welded structures**  
**Chairman:** Robert E Shaw Jnr, USA  
**Sub-Commission and Working Groups**  
 XV-A Static Analysis  
 XV-E Tubular Structures  
 XV-F Interaction between Fabrication and Design  
 XV-G Seismic Design and Fabrication

WG8 Welded Details  
 WG10 Finite Element Analysis  
 WG11 Repair  
 JWG XIII-XV Calculation of welded joints subject to dynamic load  
 JWG X-XV Residual stresses and distortion prediction and control  
 Technical topics considered  
 Static analysis of fillet welds Residual stress prediction  
 Fatigue design with multi-axial loading  
 Effective notch stress approach



Commission XVI  
**Polymer joining and adhesive technology**  
**Chairman:** Chung-Yuan Wu, USA  
 Technical topics considered  
 Vibration welding  
 Hot Plate Welding  
 Adhesive Joining  
 Laser Welding



Commission XVII  
**Brazing, soldering and diffusion bonding**  
**Chairman:** Warren Miglietti, USA

#### OVERVIEW OF IIW SELECT COMMITTEES



**SC AIR**  
 Permanent joints in new materials and coatings for aircraft engineering  
**Chairman:** Tom Mustaleski, USA  
 Technical topics considered  
 Welding and repair of engine materials



**SC AUTO**  
**Automotive and road transport**  
**Chairman:** Prof Michael Rethmeier, Germany  
 Technical topics considered  
 How joining methods can improve product properties and fabrication conditions in order to improve vehicle safety, reduce vehicle environmental influence, reduce vehicle assembly costs, improve component and crash behaviour



**SC ENVIRONMENT**  
**Chairman:** Prof Mauro Scusso, Italy  
 Technical topics considered  
 Regularly review the general trends and the implementation of the activities within the field of a sustainable environment, with regard to joining fabrication.  
 Introduce the relevant issues concerning the sustainable environment in IIW and encourage all the IIW Working Units to contribute to a sustainable environment. Share information on any national rule and produce documents helping to apply ISO 14001 standard to welding, joining and cutting processes



**SC QUAL**  
**Quality Management in welding and allied processes**  
**Chairman:** Rainer Zwätz, Germany  
**Technical topics considered**  
 Revision of EN ISO 3834 – Needs questionnaire  
 Questionnaire “Recommendation for the determination of the necessary Quality Level according to EN ISO 5817”  
 Review of WPS and WPQR  
 Achieving service life of welded products  
 Questionnaire “Overview of global used QM Systems in welding”  
 Minimum requirements for persons who examine welding qualification tests



**SC Shipbuilding**  
**Chairman:** Mr Richard Boekholt, Spain  
**Technical topics considered**  
 The work programme has been divided into three main subjects, with a central goal being the realisation of operational productivity: Advanced welding technology and engineering; Management and production organisation; and, Human resources



## OVERVIEW OF IIW STUDY GROUPS



### **SG 212**

#### **The physics of welding**

**Chairman:** Yoshinori Hirata, Japan

#### **Technical topics considered**

Modelling of arc plasma of TIG arc  
Classification of metal transfer mode  
Spatter reduction and mechanism of metal transfer in controlled bridge transfer  
GMA welding. Metal transfer phenomena of CO<sub>2</sub> gas shielded arc welding in DCEN

polarity with REM added wire

MIG arc behaviour with small amount of oxygen in shielding gas

Extremely high frequency pulsed current TIG welding phenomena



### **SG RES**

#### **Study Group Welding research strategy and collaboration**

**Chairman:** Dr Louisa Quintino, Portugal