The impact of the
International Institute of Welding (IIW)
since 1990

# linking people, joining nations

## The impact of the International Institute of Welding (IIW) since 1990

David Barnett

INTERNATIONAL INSTITUTE OF WELDING

A world of joining experience

www.iiwelding.org

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First published 2017

ISBN 978-2-9541979-3-7

Additional information pertinent to the IIW history is available on the IIW website www.iiwelding.org

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# foreword

*Professor Gary B. Marquis*
*IIW President 2014-2017*

IN THE YEARS SINCE ITS FORMATION IN 1948, THE INTERNATIONAL Institute of Welding (IIW) has grown in size and stature until today it proudly supports and represents 59 Member Countries. IIW-developed standards, best practice documents and educational programmes represent an international stamp of scientific and technical excellence for enhancing human safety and responsible economic growth via safe and appropriate use of materials joining technology.

The collaborative model of the IIW Working Units ensures that we are both an active and innovative leader but also responsive to the needs of industry, regulators and personnel. Our contributions in technical as well as education, training, qualification and certification spheres enable sustainable development in all nations – from emerging to the most advanced economies.

The success of the IIW since its creation has been built upon the foundations of commitment, cooperation and competence. It has been enhanced by the enthusiasm of thousands of individuals and the support of hundreds of organisations around the world. Members of the IIW family have invested their time, knowledge and capabilities freely for the advancement of the science and technology of materials joining and for transferring this knowledge for the benefit of all.

*Linking People, Joining Nations: The impact of the IIW since 1990* was conceived as a means of acknowledging some of the individuals and organisations who have contributed to the Institute. It also continues the narrative of our association that was begun by P.D. Boyd in *Joining Nations: a History of the IIW 1947-1990*. Beyond documenting our recent history, this book intends to inspire a path towards the future, where innovative technologies driven by visionary people are united through the IIW for improving the global quality of life.

*Prof. Gary B. Marquis*
*June 2017*

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# preface

David Barnett

> **"No good thing ever dies"**
>
> *The Shawshank Redemption*

THE INTERNATIONAL INSTITUTE OF WELDING (IIW) HAS A PROUD AND distinguished history that goes back to the early years of the 1900s when the modern concept of welding and its processes became a decisive part of a new century, which in its earliest beginnings, promised considerable change in the joining of metals and materials. The origins of IIW, therefore, can be traced back to the period that followed the first international congress on the use of acetylene which was held in Berlin in 1898 and resulted in the subsequent formation of several institutes to represent both acetylene, and to a lesser extent, welding interests.

Much discussion was to take place, as a result, on the establishment of a permanent commission to represent 'Acétylènists', as they were known. This eventually resulted in an international organisation called the Permanent International Commission on Acetylene and Autogenous Welding, abbreviated to CPI, which was formed as an outcome of an international congress held in Paris in 1923. This Commission concentrated solely on acetylene and its use in gas welding. It became increasingly clear, over time, that CPI could not fulfil the purpose of an international welding organisation because of increasing competition from metal-arc welding, which had found new prominence with a multitude of innovative techniques and processes that also included the utilisation of inert gases other than acetylene.

Following the Second Word War many of the members of the welding community, including those in CPI, actively sought to establish an institute with the expectancy that a truly international welding organisation could be formed. This was undertaken with a spirit of enthusiasm and mutual understanding to such a degree that the stage was set for the official launch of the International Institute of Welding, which took place at a conference organised by the Belgian Institute of Welding, on the 11 June 1948.

The first 40 years of IIW's existence encompassed great change. This provided the foundation for future expansion of the Institute as IIW approached and entered a new millennium. Up to this point the formative years of IIW had been covered by Philip Boyd, former Secretary General of IIW, in his book *Joining Nations – A History of the International Institute of Welding – 1947-1990*. Boyd's book provided an authoritative account of the circumstances contributing to the foundation and evolution of IIW, its background and development, as well as the inevitable economic, political and technical changes that impacted on IIW during those years. On reflection, Boyd did express disappointment that it was not possible to review, in detail, the activities of the working units, because his book was short and had to cover a diverse range of topics in a relatively limited period of time.

Much has happened since then, the detail of which is essential in understanding and analysing events of more recent years, which reflected on the great heritage that IIW had already built upon. IIW had the foresight to record the events of the last 25 years in a more comprehensive way before the detail of this was lost or became indistinct over the course of time. As author of this history, I called upon my metallurgical background and broad experience in welding, non-destructive testing, failure analysis and research into life assessment of critical power plant. Having a keen sense of history, and previously authoring *The History of Non-Destructive Testing in Australia* and *Lighting the Flame – The History of Welding in Australia*, I am indebted to IIW for the opportunity to write its history over the last 25 years. The subsequent research and writing of this history has been both rewarding and stimulating since, beyond the assembling of facts and information, it has confirmed and revealed the significant importance of welding, and the part it has played in the progress of all nations.

This narrative on the history of the International Institute of Welding from 1990-2015 is somewhat different in style to that of Boyd and reflects to a larger extent the contribution of the Working Units such as Commissions, Select Committees, Working Groups and individuals, including those of the Board of Directors, Technical Management Board, International Authorisation Board, IIW Secretariat, and many others too numerous to mention, all of whom have contributed significantly to the success of the Institute. The early chapters focus on events that formed the Institute in the years leading up to the dawn of a new millennium, including the significant changes in its structure, and the inevitable challenges that arose through combining two secretariats into a single secretariat. The remaining chapters feature a more focussed approach on the various activities of IIW with respect to publication and marketing; education, training, qualification and certification; research and innovation; standards; regional activities; health, safety and the environment, as well as IIW meeting the challenges of the future.

In order to provide continuity it has been necessary, by way of explanation, to include and refer to information that existed prior to 1990-2015, sometimes after, where this was appropriate to the story since it is necessary to give the full background to events that shaped others that followed. Frequently, it has been necessary, within a given chapter, to retrace one's footsteps backwards to cover parallel developments of another important topic, or issue, which had to be dealt separately to the other. It is inevitable also that duplication will occur in some chapters, but this has been avoided where possible, or used from a different perspective.

Such an undertaking, in recording IIW's history, has required the assistance of many IIW members who have either contributed information, or have become directly involved in reviewing specific chapters, and they are sincerely thanked for their participation. Their contributions have ensured that a human dimension has been added to this history of IIW. Thanks also go to Cécile Mayer and the staff at the IIW Secretariat who provided access to a wide range of material from IIW's archives, and special mention must go to Chris Smallbone, Chairman of the Task Group History whose vision, input and enthusiasm for the project were boundless.

I trust that you find this history of IIW informative and interesting and that it is a source of inspiration for Institute members to continue its proud heritage as the leader for those involved in welding and its processes into a future that is an 'unending adventure at the edge of uncertainty' (Jacob Bronowski 1908-1974).

*David Barnett*
*Fellow of the Institute of Materials, Minerals and Mining (UK)*
*March 2017*

# acknowledgements

PEOPLE MAKE THE WORLD GO AROUND AND THIS HISTORY OF IIW, so ably written by David Barnett, is a perfect illustration of this. The excellent team effort, involving so many individuals and organisations with their contributions, is commendable.

We are indebted to the IIW Members (Appendix 10) which have sponsored the work required to produce the book and the IIW Board of Directors Task Group History which has project managed the book. Members of the Task Group and reviewers are listed in Appendix 2.

Since 1990, many of the people involved in IIW have retired or passed away, but their legacies have carried on, which has enabled IIW to continue to move forward with great confidence and success.

Over the years, IIW has been fortunate to have had the involvement of so many Directors, Working and Administrative Unit members, Secretariat staff and representatives of Member Countries, each of whom has contributed such positive cultures and attributes. These include integrity, work ethic, skills, experience, helpfulness and generosity of spirit which have made the IIW a pre-eminent organisation.

A special tribute must also be given to the IIW Presidents of the period (Appendix 5) who, through their exemplary leadership, have assisted in the continuous (and continuing) positive growth of IIW.

The interviews with the author and reviews undertaken to make this book possible are truly appreciated.

In this regard, the contributions from the following people are gratefully acknowledged: Daniel Almeida, Daniel Beaufils, Michel Bramat, Ang Chee Pheng, Luisa Quintino, Luca Costa, Andrew Davis, Dorin Dehelean, Norman Eaton, Marcel Evrard, Noëlle Fauriol, John Hicks, Detlef von Hofe, Damian Kotecki, Ernest Levert, John Lippold, Doug Luciani, Mathias Lundin, Gary Marquis, Cécile Mayer, Bruno de Meester, Bertil Pekkari, Jan Pilarczyk, Martin Prager, Bob Shaw, Glenn Ziegenfuss, Norman Zhou and Wolfgang Zschiesche.

Members of the review panel are listed in Appendix 2. Norman Eaton, Damian Kotecki and Glenn Ziegenfuss, as well as several members of the IIW Board of Directors, have also reviewed the text and provided valuable comment on its structure and content.

The author has made every effort to include key issues and all the many people involved during the period; however we do ask to be excused any omission or oversight that may have inadvertently occurred. At the end of each Chapter there is a list of endnotes referencing the sources of information used, many of which are confidential and not available for access but help validate the text.

It would be remiss, at this juncture, not to emphasise the contribution of the author, David Barnett who with patience, engagement in the process and willingness to make himself available for discussion at all times, has taken a disparate wealth of information and moulded it into a highly readable and informative book.

Thanks should also be extended to Anne Rorke for her excellent editing skills, and to Chris Burns who has provided help and advice in the publishing phase to enhance the presentation of this book.

In conclusion, I would like to express a personal word of thanks to all the many wonderful people who have been involved in IIW in improving the global quality of life through the optimum use of welding.

*Chris Smallbone*
*Member of the IIW Board of Directors*
*IIW President 2005-2008*
*Chairman, IIW Board of Directors Task Group – History*
***Nil satis nisi optimum – Nothing but the best is good enough***

chapter 1

# towards 2000

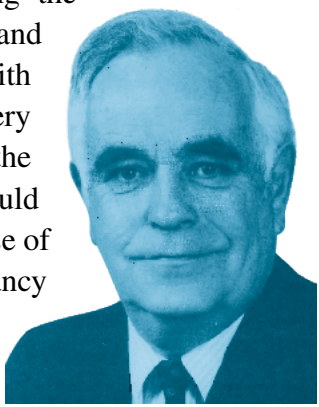
**"Together we meet the challenges before us"**

*Dr Norman Eaton, President 1990-1993*

*Prof. Fujita addressing the IIW Governing Council meeting at the 47th IIW Annual Assembly, Beijing, P.R. China, 1994*

AT THE GOVERNING COUNCIL MEETING DURING THE IIW ANNUAL Assembly in Montreal, Canada, in 1990, the incoming President, Dr Norman Eaton (Canada) mentioned that the International Institute of Welding (IIW) faced new challenges and opportunities in a time of rapid change. In doing so he introduced a new vision for IIW – *Towards 2000*.[1] This was reminiscent of when, 10 years earlier, The Netherlands delegation had a similar vision when it requested that IIW redefine its future, at the Governing Council meeting in Portugal in 1980. The need for change received further impetus following the appointment of Dr Felix Wallner (Austria) in 1984 as the President of IIW. Wallner then nominated Eaton, a fellow member of the Executive Council, to become Treasurer and work alongside him, since both these individuals were of similar disposition and outlook.

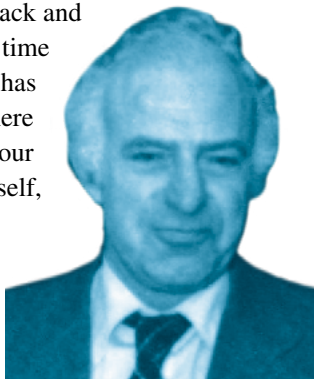
In 1989 the Executive Council then decided to act more decisively before the start of a new decade by disbanding the Working Group (WG) *Commercial Strategy* and replacing it with a new WG *Strategic Planning* with Eaton as Chair. In assuming this role Eaton gave every appearance that he was a man who had come to the conclusion that IIW had to reinvent itself or it would fast become irrelevant as a global leader in the cause of welding and its processes. There was some expectancy that significant changes were about to take place when Eaton reported the provisional findings of the first strategic planning group meeting to the Executive Council in March 1990.[2]



*Norman Eaton*

Accompanying the rationale expressed in the findings of this report there was a feeling within IIW that it still had its roots in the past and had changed little since its inception. This feeling, in fact, had existed as far back as 1976 when a certain degree of dissatisfaction with the direction that IIW was taking was expressed by the Director General of The Welding Institute (TWI), Dr Richard Weck (United Kingdom (UK)), in his opening address to the Public Sessions at the IIW Annual Assembly held in Sydney, Australia. He

reminded everyone that 'From time-to-time one must stand back and take stock of an activity that has gone on for a very long time along certain well-defined paths and ask oneself where one has got to; whether one is travelling in the right direction and where one is hoping to arrive. Different people will, of course, favour different answers and men of advancing years, such as myself, will inevitably be somewhat more pessimistic and critical.'[3]



*Philip Boyd*

Weck was also dismissive of some of the activities of the IIW Commissions indicating that 'the conclusion is inescapable that we have started to go around in circles'. These remarks by Weck were received rather uncomfortably at higher levels in IIW and Mr Philip Boyd, General Secretary of IIW 1968-1990, considered Weck, the first chair of Commission X *Residual Stresses* (C-X), to be 'a long-standing and highly critical member of the Governing Council and Technical Committee'.[4] In retrospect, there was an element of truth in what Weck was trying to get across to what he felt was an unresponsive executive at that time. If his comments carried any weight then Eaton, the incoming President in 1990, would not find it easy to turn around an organisation such as IIW during his coming period of tenure of only three years. The WG *Strategic Planning* was the vehicle which Eaton expected would deliver cogent reasons for determining a new vision for a revitalised Institute. It was stated as part of the working group's terms of reference that it was not to involve itself in technical matters, since these were considered to be strictly the role of the Technical Committee and Commissions and no one else.

Wallner had previously made a great impression on Eaton who considered Wallner to be one of the most important persons in changing the direction of IIW. Wallner's influence had brought a new perspective to the Institute since he was the first industrial executive to have a significant influence on IIW. Eaton and Wallner then worked closely together in order for IIW to have a more commercial/industrial focus since, previously, most of the executive/presidents were of an academic or Member Society background.[5]

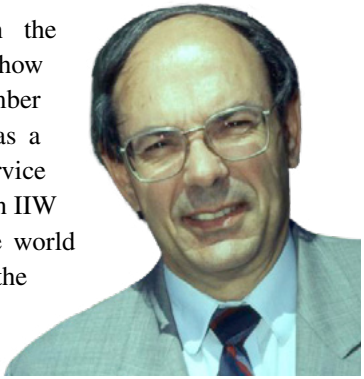
One of the key strategies noted in the WG *Strategic Planning* paper delivered to the Executive Council by Eaton was to respond to the needs of Member Societies far better than before. It noted that IIW also needed to reflect socio-economic issues of the day. In particular it lacked direction with regard to working for the benefit of mankind and other living creatures, directly and indirectly, through not recognising the frailty of the world's environment.[6] This topic had already received some support from another direction when the joint Presidents of the International Organization for Standardization (ISO), and the

International Electrotechnical Commission (IEC), had already stressed in their World Standards Day message that '…survival itself is at stake'. In stressing the importance of their words the two Presidents signalled what the future was likely to be with respect to standards and their involvement in changing minds and opinions. 'Let us not forget that it is technology which in the long run will give our children and their offspring a world fit to live in … this technology is the heart of the world standardisation effort.'[7] IIW, inescapably, was destined to be part of that effort also.

This theme was later to be reflected in the expected challenges of the 1990s when trying to bring about environmentally sustainable growth in an economical and equitable way. It was something that IIW had to be cognisant of, more so since other authorities, such as the Union of International Technical Associations (UITA), were also applying pressure by suggesting the adoption of a more environmentally friendly approach to their policies.[8] IIW was to take on such issues and garner a more serious attitude to social responsibility in the new millennium.

In consideration of this, the relationship with ISO and other international organisations was of extreme significance, particularly since IIW had become an international standardising body approved by ISO to develop standards in the field of welding and related processes in 1986. There were ominous signs that this relationship was starting to wear thin in the early 1990s due to the fact that IIW did not fully appreciate the significance and value of the approval it had received from ISO, or adhere fully to ISO practices and documentation.[9] Additionally, it had no effective working system in place to assist the standardisation process. The warning messages received from ISO on IIW's performance appeared to have gone unheeded at this time despite the possibility of IIW losing its status with ISO.[10] There was much to do therefore, in the 1990s, to improve the relationship with ISO and other standards authorities such as the European Committee for Standardization (CEN).

Actions to improve these relationships were of great urgency and signified more than anything the dichotomy that IIW now faced. It was producing work of great importance from among its Commissions, however inertia in decision-making was impacting on its relationships, both within and without the Institute, as an effective welding organisation. One of the problems was the lack of standards writing knowledge within IIW and the difficulty in complying with the exact ISO format. The IIW Scientific and Technical Secretariat provided by the French Institut de Soudure and others within IIW worked to resolve these issues and the Scientific and Technical Secretary, Mr Michel Bramat, was to report later that, as far as relations between IIW, ISO and CEN were concerned, procedures to harmonise the working programmes of these three organisations were now under development.[11]



Michel Bramat

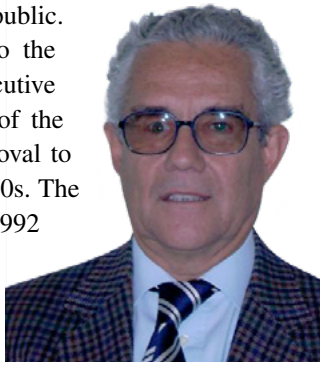
Another of the major issues highlighted in the provisional paper by the WG *Strategic Planning* was how IIW was seen from a global perspective. With Member Countries of IIW now distributed worldwide there was a need to grow the momentum on deciding how to best service these countries. There was also a widely held view within IIW that it was not making itself sufficiently visible to the world at large and that the main vehicle for promoting IIW, the *Welding in the World* journal, was not serving as useful a purpose as it might have and was less appealing than many other publications. It was also considered in the strategic plan that *Welding in the World* could be more attractive and therefore would receive a wider readership if it were to contain items of relevant news as well as publishing technical documents.[12] One rather undisguised issue was that the journal was bilingual, being published in both English and French, a further disincentive for the readership and limiting the number of articles in any one issue, while translation added greatly to the costs of publishing. This problem was resolved when English was adopted as the preferred language of IIW in 1994. Bramat was to agree with this resolution and was to comment that 'The English language was better used by all the participants as far as it prevailed as a worldwide language of exchange. Dropping the French language was not a major technical problem and it was agreed, in principle, to adopt English as the official language of IIW.'[13]

Bramat also identified real issues experienced by a number of individuals and Member Countries in obtaining the greatest benefits from IIW. The implication from his conclusions was that '…the vehicle itself is satisfactory but its journeys and destinations needed to be defined within the context of a changing world'.[14] Bramat's comments echoed to some extent the words of Weck two decades earlier.

The changing world was no better emphasised than by IIW's limited facilities for communication at that time. Contact by telephone, telex and fax were considered more than adequate when the WG *Strategic Planning*'s paper was delivered in the early 1990s. Thus the strategic plan did not take into account that by 1990 the World Wide Web had come into being and Bill Gates' Microsoft Windows 3 had made its debut, both heralding great changes in communication in the years to come.

The faith placed in conventional means of communication, therefore, had to change significantly. Importantly, IIW had already shown excellent leadership on other technical issues such as the development of a computerised database containing records of technical documents prepared by its various Working Units and making the information contained

in these documents available to industry and the general public. Modernisation was the key to upgrading IIW's service to the membership and, following its initial presentation to the Executive Council, the WG *Strategic Planning*, under the guidance of the Chair Dr Giulio Costa (Italy), was then given official approval to provide a new-found platform to guide IIW through the 1990s. The final report was delivered to the Executive Council in July 1992 after several meetings, the last being in Madrid, Spain, in May 1992.[15] The report was comprehensive and covered both the strengths and weaknesses of IIW and looked at the 'big picture' opportunities rather than solving the specific problems that IIW currently faced.

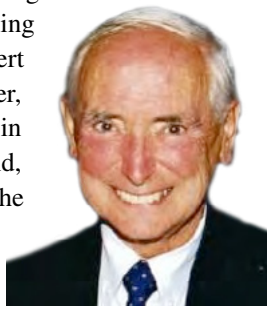


*Giulio Costa*

One of the strengths of the Institute was its high professional standing in government, industry, research institute and university circles. The current structure of IIW was considered to be a powerful administrative machine for communication between welding societies and individual specialists of many disciplines on a worldwide basis. IIW did have weaknesses, the most important of which had been evident for some years – the length of time that it took for actions to be implemented.

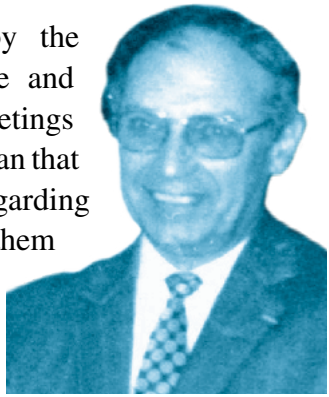
One would suspect that such criticisms were aimed at the long-held constitutional requirement, 44 years in fact, for the registered office to be situated in the country where the General Secretary was based, at that time the UK. It was commented that legal opinion, as defined by English Law, meant that the Institute was an unincorporated company, a matter that would not have sat well with some members of the Executive Council since it meant that IIW had no legal status at all. The final conclusions of the report did recommend a number of initiatives and a need for the Executive Council to be restructured so that Vice-Presidents became responsible for specific areas and operation of corresponding working groups.

During Eaton's Presidency 1990-1993 the concept of a single secretariat was progressively developed and received increasing support by most members of the Executive Council. Mr Robert Salkin (Belgium), who was President 1987-1990 was not, however, in favour of a single secretariat although the incoming President in 1993, Mr Raül Timerman (Argentina), with an industrial background, fully supported a single secretariat.[16] Following the release of the findings of the WG *Strategic Planning* a total of 12 members responded with suggestions. Inevitably, many were to question the current practice of having both a General Secretariat in the UK and a Scientific and Technical Secretariat in France.



Robert Salkin

This led to renewed debate, sometimes behind the scenes, at meetings and Annual Assemblies such as the 46th Annual Assembly in Glasgow, Scotland in August 1993. This became what could be termed a 'burning issue' leading to an extraordinary meeting of the Executive Council where a submission written by Dr Glenn Ziegenfuss was put by the United States of America (USA), supported by Canada, to consider a proposal for the establishment of a single secretariat.[17] The Executive Council decided to approach this matter with deep reflection and to make a decision based on a cost versus benefit analysis. This eventually resulted in a request for the institutes hosting the two different secretariats to put forward costed proposals for providing IIW with a merged function, including an Executive Director and support staff.[18]



*Marcel Evrard*

Two subsequent meetings were held by the Executive Council to further examine the role and objectives of IIW. The combined result of these meetings was for the Institute to come up with a corporate plan that incorporated the views of Member Societies regarding the outcomes of the strategic plan and absorbed them into a plan for future action. In discussing the administrative structure, the single secretariat suggestion was examined initially by the Executive Council but no benefits could be identified over the current arrangement. Despite this finding there was still an element of tension within the IIW community, particularly between the British and the French delegations. Mr Marcel Evrard, the Director General of the Institut de Soudure, was to comment that 'relations had been tense during previous years when the merging was discussed in small groups, and internally at the Executive Council, before 1990'.[19]

Pride and a possible sense of history was an inordinate part of the British consciousness[20] and the potential loss of the General Secretariat to the French would have been difficult to contemplate if it indeed was to become a reality. Across the Channel, French pride would have come into play too in the eventuality of any decision being made that included the likely loss of the Scientific and Technical Secretariat to the British. One consideration, not widely known or expressed at that time, was the likelihood of the payment of considerable value added tax (VAT) in France if the secretariat was situated in Paris, whereas IIW's current status with the secretariat based in the UK meant that no tax would be required on its financial transactions.

Besides these considerations, it was a time of great social and political upheaval in Europe following the breakdown of the Soviet Union when the Baltic, east European

and Caucasian states declared independence. Both East and West Germany were to merge into the one Germany after decades of physical separation and, when Iraq invaded Kuwait, the Middle East was to deliver uncertainty to an unsettled world. The Balkan Wars were another serious concern when Yugoslavia collapsed and Slovenia and Croatia declared independence. Within a short time, in 1993, the European Economic Community eliminated trade barriers and created a single market. The Maastricht Treaty also took effect, formally establishing the European Union with all the concomitant effects that it would have on terms of trade, labour markets and many other issues that would impact on IIW and the welding industry.

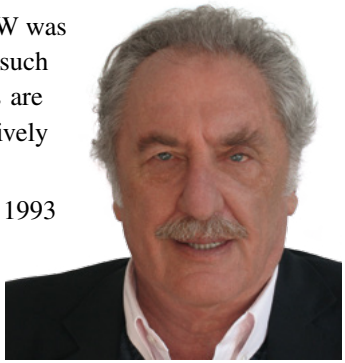
*Slobodan Kralj*

Initially it was thought that the massive political and structural changes presaged a period of peace and political stability in the world. Such expectations were to come to naught very quickly. What effect this would have on IIW was unknown but the immediate concern would be a decline in membership numbers. Dispelling fears to some extent, both Slovenia and Croatia acted quickly by applying for separate IIW memberships and were accepted as individual members a short time later which brought the total membership to 39 countries. Similarly, when Czechoslovakia broke up into two distinct countries (Czech Republic and Slovakia) any potential loss of membership was averted when both re-joined IIW as individual members.

In questioning IIW's role in these uncertain times Prof. Slobodan Kralj (Croatia), after undertaking a study on the composition of IIW, was quick to draw comparisons. 'It was noted that of the 39 members of IIW most are mainly industrially developed countries with a high gross national product. Generally those countries that might have significant benefit from IIW are poor and industrially under-developed countries.' Kralj was to comment further that '…this imbalance was due to lack of understanding of the structure and work of IIW', indicating that such countries were unaware of the benefits and role of IIW and how it was able to assist them.[21] Despite the uncertain times, Iran (1990), Romania (1990), Greece (1991) and Russia (1995), along with Slovenia and Croatia (1992), the Czech Republic and Slovakia (1993) were added to or re-joined the ranks of the IIW membership over this period of instability.

The turmoil and upheaval in the political structure of Europe did have profound effects on Member Countries as well as for IIW. The Secretary General of IIW was to make general comment on this. 'Of particular significance to the IIW is that for the first time the effect of international sanctions has prevented us from conducting our usual business

with one of our Member Societies, a position which the IIW was once proud to boast about.'[22] He finished in saying '…at such time we must ensure that relationships among individuals are strengthened and communications are maintained as effectively as possible'.



*Raül Timerman*

To compound the issues that IIW faced, the year 1993 was one where a worldwide recession took place, which did have an effect on Annual Assembly attendance and on the Institute's membership, with several countries in danger of having to forfeit this due to non-payment of membership fees. Despite IIW taking a strong stance and a liberal attitude, trusting that outstanding fees could be recovered quickly, this state of affairs was to continue right through the 1990s with as many as 12 members having difficulty in payment of arrears.[23] The method of determining the payment of fees, based on the quantity of steel used on a pro-rata basis, was questioned in higher circles and started considerable debate. Some of the countries with high steel consumption rates were not necessarily among the wealthiest of countries.

Timerman was also to comment on the additional cost of persons representing Member Societies at an executive level as well as those individuals attending Working Group and IIW Commission meetings. This, if anything, underscored the great strength of IIW in having, within its ranks, a diverse range of welding professionals who were willing to dedicate their time and effort in a voluntary way to advance the cause of welding technology and science. Timerman had a commendable attitude to his role as President 1993-1996 and understanding of the principles of governance. His first words to the Executive Council were '…remember you are here as Directors representing IIW and all of its membership and not your Member Society'.[24] Timerman did seek individual counsel with several members of the Executive Council on how best they could help IIW, with particular emphasis on regional development and the pursuance of a global education, training, qualification and certification scheme.

Some of IIW's longest serving members were close to retirement and a changing of the guard was contemplated in several key positions. Boyd, for instance, retired in 1990 after 42 years continuous service, the last 22 years of which were as Secretary General. Boyd was a man of great distinction and admired by those around him. He did not completely sever all connections with IIW and his immediate retirement was spent in writing the history of IIW, *Joining Nations – A History of the International Institute of Welding 1947-1990*,

*The first modern welding technology stamp in the world issued by South Africa*

an authoritative account that was published in 1993. The front cover of Boyd's book, incidentally, depicted postage stamps of many nations that were associated with welding and its processes. This brings to mind the external pursuits of Prof. Fukuhisa Matsuda of the Japanese Welding Research Institute at Osaka University in Japan, and his colleagues, Dr Itsuhi-ko Sejima and Dr Takashi Nakamura, who assembled a unique collection of postage stamps from around the world that depicted various forms of welding and its practices. These were published in a later book translated into English by the three authors and published by the Osaka University in 1996.[25] Among these stamps was the first ever stamp on arc welding issued by South Africa in 1941.

*Henry Granjon*

Boyd made many friendships including a lasting one with Mr Henry Granjon who had also been associated with IIW since it was founded in 1948. They were of equal status in terms of their contribution to IIW and were part of its success over the many years that they were associated with one another. Granjon believed that knowledge had little value unless shared by everyone.[26] There was a great sense of loss when Granjon died in 1992 but his memory lived on through the IIW Henry Granjon Prize, which was established to recognise the achievements of research students, a cause that he was extremely supportive of and interested in. The prize, sponsored by the Institut de Soudure, was first awarded in 1992.

*Vice-Prime Minister Zou Jia-hua of P.R. China opening the 47th IIW Annual Assembly in Beijing, 1994*

Boyd was replaced by Mr John Hicks as Secretary General of IIW in 1990. Hicks worked particularly hard at establishing himself in that position and through his editorials he was a keen observer and commentator on world politics. Aware of the pressures of the Secretariat he worked assiduously to protect its image and to present it in the best way possible. Nor was there any certainty that Hicks would remain as Secretary General should TWI be successful in winning the bid for the single secretariat. There was considered opinion circulating that Hicks had already been informed that someone else would be taking on the future role of Secretary General should TWI be successful. Hicks, clearly, was a seasoned and shrewd reader of the political landscape and was aware that he did not have the full support of Mr Bevan Braithwaite who was Chief Executive Officer (CEO) of TWI. Correspondingly he did not play a part in the TWI bid for the single secretariat, which was prepared entirely by Braithwaite's office.[27] Considerable time and effort was expended in gaining support for the TWI proposal, as one might expect, with Eaton coming into consideration for the position of Secretary General on account of his wide experience of IIW affairs.[28]

The pressure for the resolution of the secretariat crisis intensified as the date on which a final decision would be made approached. The scene was set to clear up any further uncertainty at the next meeting of the Governing Council in Stockholm on 11 June 1995 where TWI and Institut de Soudure would each present their case for undertaking the duties of a single merged secretariat. As President of IIW, Timerman was to preside over the proceedings. After the initial formalities had been completed the proposal for restructuring the secretariat was addressed.

It was noted that during the last four Annual Assemblies, the members of the Governing Council had expressed to the Executive Council their views on combining the two secretariats. At the Beijing, Peoples Republic of China (China) Annual Assembly in 1994, a vote had been taken on the specific resolution by the Governing Council but it did not receive the required level of support since it did not quite achieve the two-thirds majority required. Nonetheless, a large number of Member Society delegations did support the proposal. In light of this the members of the Executive Council at that time were of the opinion that this matter warranted further consideration, bearing in mind that the average annual cost of running the combined secretariats was in the order 518 000 Swiss francs (CHF).[29] Timerman had advised, in addition, that the establishment of the new single secretariat would require a change to the constitution if the proposal was approved by the members at this Annual Assembly.

After due and careful consideration and the analysis of the bids from TWI and the Institut de Soudure, Timerman informed the Governing Council in June 1995 that the Executive Council's recommendation was for the Institut de Soudure to be awarded the merged secretariat role, at an annual fee of CHF 431 795 and with Mr Michel Bramat as Executive Director. This resolution was then put to the Governing Council for approval by secret ballot, counted by Timerman, with 24 Member Societies voting in favour, six against and three abstentions. Having achieved a majority of more than two-thirds of the vote the proposal was approved.

It was an historic day for IIW in more ways than one – another important proposal included approval of a resolution for the establishment of Commission VII *Authorisation and Qualification* (C-VII) with all its implications with regard to the establishment of an IIW International Personnel Qualification and Certification Scheme.[30] This, in itself, was an endorsement of the sterling work done by Working Group 13 of IIW's Commission XIV *Education and Training* (C-XIV) over the previous three years led by Mr Chris Smallbone (South Africa).

*John Hicks*

Both Bramat and Hicks paid compliments to one another after the decision had been announced. Hicks made a considered address to the Governing Council at its second meeting on 17 June 1995. It was a speech that impressed everyone who was there as a sign of acceptance of change and of the immense challenges ahead. At first Hicks had some misgivings. 'My feelings this time are of some frustration that having begun to grasp fully the complexities of IIW and the widely

differing structures and interests of the Member Societies, I am now unable to lead the implementation of some of the major improvements in the administration and functions of IIW that such understanding would have brought.' He continued by saying, 'You will know that the role of the Secretary General and one of the Scientific and Technical Secretary were complementary and one had no authority over the other. In this situation it would be easy for the business to be unmanageable. However, in Michel Bramat, I found a colleague and in time a friend I could work easily with and with a shared view of where IIW should go. I ask you, in the coming year, to recognise the immense change which will have been wrought in the organisation and to be tolerant of the inevitable problems.'[31] It was decided by resolution that Hicks would hold the title of Honorary Secretary General for one year during which time he would assist in the transition between TWI and the Institut de Soudure.

The corks popped and the champagne flowed in Bramat's hotel room that night and the staff of the Institut de Soudure celebrated in true French fashion until the early hours of the next morning. Evrard recalled 'I remember to have crossed one of the UK delegates on the stairs and he suddenly issued … "You must be happy now". I retorted, "Yes we are!"'[32]

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# the approach of the new millennium and thereafter

chapter 2

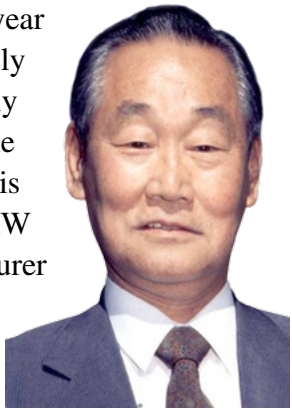
**"Remember the only real money is the money in the bank"**

*Mr Bevan Braithwaite, IIW Treasurer 1996-1999*

*IIW Board of Directors 2004*

IN A TIME OF CHANGE THE MAIN ISSUES OF THE DAY WERE THE FORMIDable challenges that lay ahead as IIW moved towards a new millennium. In 1996 Prof. Yuzuru Fujita (Japan) became the first President to be elected from an Asian country while Mr John Hicks remained on the Executive Council through his new role as the Honorary Secretary General. Hicks was also entrusted with additional duties as IIW's Standardisation Officer. He presumed that this was because Mr Michel Bramat would not only have the duties of Secretary General to contend with but would also have a substantially expanded Secretariat to administer.[1] The standardisation role, therefore, was a suitable one for Bramat to pass on to Hicks, who was now employed directly by the French Institut de Soudure.

No longer responsible for finance, Hicks informed the Executive Council that the accounts for the year ending December 1995 had been prepared entirely by the auditors.[2] These accounts were subsequently returned to the auditors for re-evaluation since the figure for bad debts was considered to be too low. This made a substantial difference to the finances of IIW and Dr Giulio Costa (Italy), accordingly, as Treasurer at that time, was to inform the Executive Council that the financial situation of IIW for 1995 had deteriorated significantly and that the result was a deficit of over CHF 100 000, the highest deficit that IIW had ever had.[3]

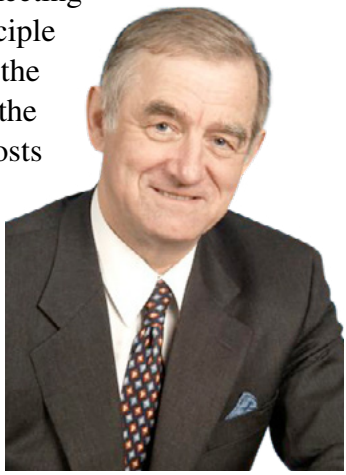


*Yuzuru Fujita*

This was due in part to the restructuring costs in merging the two Secretariats, which amounted to CHF 48 000 in total. The rest was due to non-payment of membership fees that generally formed around half to two-thirds of IIW's annual income. The question of outstanding fees was a vexatious problem for IIW and had been for many years. Dr Norman Eaton (Canada), Treasurer of IIW before becoming President in 1990, had spent some time in analysing the financial threats to IIW during the late 1980s. He then presented his strategy for future financial planning and control of operations at a meeting of the Executive Council.

One of Eaton's principal concerns at that time was that several Member Countries' fees had increased significantly in recent years. This had arisen not only due to planned revenue requirements but was also the result of currency changes in many countries. Traditionally the method of determining fees was based on the amount of direct steel consumption in each Member Country. Eaton considered that this method was problematic because of the high proportionate values for some countries which had the potential to affect future membership subscriptions.[4] Subsequent changes to the fee structure failed to arrest this continuing problem and, at the time of the 1995 budget mentioned previously, nine Member Countries were substantially in arrears.

Following Costa completing his term as Treasurer, Mr Bevan Braithwaite (UK) accepted the offer to take over as the new Treasurer in September 1996. In the interim, Bramat had become increasingly concerned at the escalating costs of restructuring and had decided to suspend payments to TWI for the salary of Hicks, in consideration of the fact that he was also being remunerated by the Institut de Soudure.[5] This issue was taken up by Braithwaite at his first meeting as IIW Treasurer and he indicated that the principle of having these costs reimbursed was part of the original offer made by TWI when bidding for the single IIW Secretariat. He made it clear that the costs corresponded to what had being paid to the former IIW Secretary General for a contract that had been already approved and could not be breached, at least until well after the Institut de Soudure took over the responsibility for the IIW Secretariat.[6] After detailed discussion it was agreed that TWI should be reimbursed for their costs resulting from the merging of the two Secretariats.



*Bevan Braithwaite*

Braithwaite, characteristically was a down-to-earth sort of person and had a deep interest in the restoration of old steam engines, including the renowned *Flying Scotsman*, a model of which had a significant place in his office at TWI. He was also a qualified Class 1 welder and a world authority on fatigue strength of structures.[7] He was an astute observer and was quick to express himself directly on occasions. When Bramat explained why it was not possible to present a financial statement for the year 1996 he was far from impressed. The reasons offered for this, as Bramat explained, were numerous including the change-over from the previous bookkeeping system, issues regarding French law, devaluation of the

Swiss franc plus the possible imposition of VAT which, in total, required a study of all the possible scenarios and consequences of IIW's tax position.[8] Bramat did inform the Board of Directors (formerly Executive Council) that he already had information from the French taxation authorities, to be confirmed in writing, that IIW would be authorised to recover VAT for the next financial year.[9]

Braithwaite's first reaction to this was to introduce a much harder line regarding the payment of membership fees, including possible expulsion from IIW, since this was a major factor in the continuing deficits that IIW faced. Making provision for, and having to set funds aside for, VAT payments to the French Government also compounded the situation further. Despite these issues the light at the end of the tunnel appeared to be getting brighter. Braithwaite now felt more comfortable as Treasurer since he was now in a position to be a bearer of good tidings. At the General Assembly (formerly Governing Council) in 1997 he was to report that, following the record deficit in 1995, the accounts for 1996 had actually shown a small surplus of CHF 16 840. He then drew attention to the fact that making a loss was normal – the organisation had never been really profitable, at least over the last 15 years. He demonstrated that IIW had made continuous losses that had reduced its reserves from around CHF 300 000 in 1981 to approximately CHF 40 000 by 1995. As a consequence, the reserve funds were now considered to be insufficient to maintain the services of the Secretariat for more than a few months.[10]

This needed to be addressed as quickly as possible and Braithwaite made an open pledge that by the year 2000 the reserves would be returned to where they were previously. This proved not to be an idle promise. After changing its currency to French francs (FRF) in 1998, IIW achieved a remarkable turn-around in its financial situation by amassing a total of FRF 690 000 in reserve at the end of 1999 largely due to payment of arrears by a number of members, including Russia, which had successfully disputed the level of fees required. Most of this surplus had then been put to one side in the eventuality, or otherwise, of having to pay VAT. The thought of having to pay such a tax was anathema to Braithwaite and resulted in some differences with Bramat who still had extreme difficulty in providing a clear indication of what the current situation was on the payment of French VAT.[11]

Tiring of inaction, Braithwaite was to stress at the Board of Directors meeting in Hamburg in September 1998 that 'if the French Government decided that all the money provided in the reserves was owed to them, then IIW would, in fact, be technically bankrupt'.[12] He then indicated that it was his expectation that the Institut de Soudure, as the supplier of IIW Secretariat services, should act as guarantor if such a situation did arise. Further, he added that IIW would be seeking an assurance from the Institut de Soudure that they would

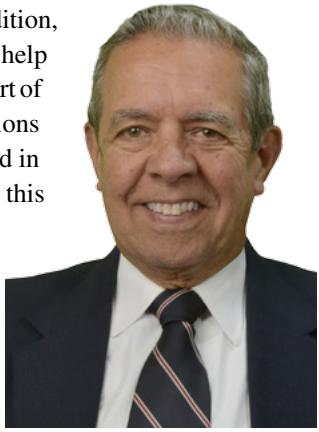
underwrite the financial viability of IIW in the event of a negative result from the French taxation authorities.[13] Braithwaite then confirmed that he had no alternative but to report to the General Assembly that the payment of the tax was yet to be resolved, and that he would get back to them on the situation in one month's time. His directness won the day and the General Assembly was to express its full confidence in his recommendations and gave him the necessary backing to resolve the VAT crisis. Braithwaite's philosophy regarding finance was quite simple and he was heard to say on at least one occasion, 'remember, the only real money is the money in the bank'.[14]

The Institut de Soudure then took the necessary measures to financially protect IIW back to the beginning of January 1996. It enlisted the support of a high level consulting bureau to evaluate a new Directive on VAT that had been published at the time of the General Assembly in Hamburg. A complete file on IIW's taxation provisions was provided to the French taxation administration and it was subsequently ruled that tax of FRF 140 000 would be payable for the years 1997 and 1998 only and that the FRF 900 000 held in reserve was recoverable.[15] This was a major victory that all shared. Both the Treasurer and Bramat in particular, were understandably delighted that IIW's financial reserves now remained inviolate. The potential threat of insolvency and bankruptcy had at last been lifted.

By way of explanation, some years later, Bramat was to offer the opinion, 'It is true that the one question to be resolved was the VAT problem. It was technical and a bit unusual because there was no international secretariat comparable to IIW existing in France. The question was finally resolved with the help of a person working in a financial journal who was well recognised by the French taxation system. This took some time because when you are dealing with this kind of problem – paying less tax – it is necessary to find the right kind of person to convince the tax authorities, which turned out to be successful in the end.'[16]

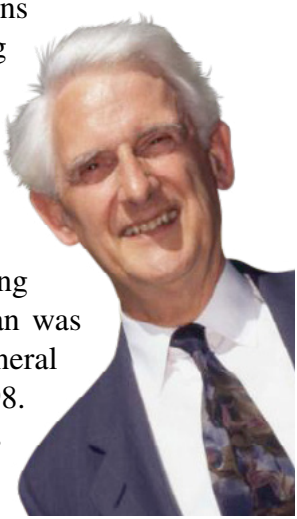
The first draft of a new IIW Constitution was presented to the Executive Council in Chicago in April 1996 and, following a number of revisions and editorial changes, this important document was presented to the Governing Council for approval at its subsequent meeting at the Annual Assembly in Budapest that year.[17] The most obvious of these changes was confirmation that the Executive Council would now be called the Board of Directors and the Governing Council would be called the General Assembly. The other significant change was to limit the Chairs' term of office on Working Units to three years, with the possibility of renewal for three consecutive terms, instead of an unlimited period specified in the original Constitution. Of equal importance was the need to develop a set of bye-laws and procedures to underwrite the operations of IIW and provide the means by which it was to be governed. After undergoing several revisions a final draft was prepared and the new IIW Bye-Laws approved by the General Assembly at its San Francisco meeting in 1997.

Dr Glenn Ziegenfuss (USA) recommended that, in addition, a visionary/strategic planning session should be held with the help of a facilitator, to progress strategic planning as an important part of the Institute's future planning process. Despite some reservations about timing, a successful strategic planning meeting was held in Abington (UK) in late November 1997. In conjunction with this meeting, Eaton also undertook a review on behalf of IIW through a questionnaire distributed to Member Societies. The response from the questionnaire and the results of the strategic planning session were used as the basis for the development of a Business Plan that was then circulated to Member Societies. The document produced as a result of the meeting was quite comprehensive and covered some sensitive issues including a proposal to review the existing scopes of all the Working Units, including restructuring the Commissions. Mr David Reynolds (Canada), the Chair of the Technical Committee, relayed comments back to the board that little dissent had come from the Working Units and that they were comfortable with the proposals.[18]



*Glenn Ziegenfuss*

IIW had also commenced protracted negotiations with the European Federation for Welding, Joining and Cutting (EWF) for the creation of a joint personnel qualification scheme. This eventually led to a preliminary agreement between the organisations at the IIW General Assembly in San Francisco in 1997 where the launch of the joint scheme was officially announced.[19] Following this, a further detailed revision of the Business Plan was unanimously adopted by the membership at the General Assembly meeting in Hamburg on 13 September 1998. One of the main objectives of the Business Plan was the establishment of a universal scheme for the education, training, qualification and certification of welding personnel. IIW was now in a sound position to possibly provide the level of financial backing needed to fund such a scheme, based on the favourable decision by the French Government that allowed IIW to recover VAT taxes attributed to its financial transactions.



*David Reynolds*

Setting up an IIW International Authorisation Board (IAB) and global scheme then started to gather pace as various resolutions were adopted by the General Assembly at its

meeting during the Annual Assembly in Lisbon, Portugal in 1999. Mrs Rute Ferraz (Portugal) became the Chief Executive Officer (CEO) of the IIW IAB and was to play a vital role in the overall administration of IAB activities. With appointments of other positions finalised, the required infrastructure was then put in place for the commencement of one of the most important initiatives ever taken by IIW – the implementation of a harmonised global education, training, qualification and certification scheme.

*Rute Ferraz*

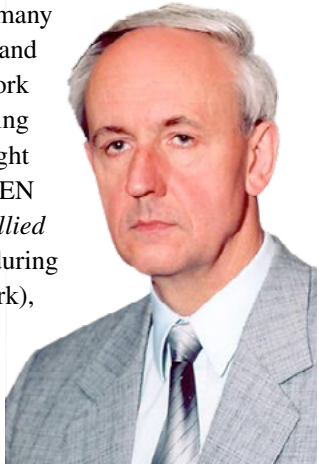
Working Groups on regional activities and liaison with developing countries, championed by Mr Chris Smallbone (Australia), and the environment, championed by Mr Bertil Pekkari (Sweden) reflected IIW's sensitivity to contemporary world issues. These were core initiatives that became embedded in IIW's planning cycle. Their establishment reinforced a need for action on both these issues which were of great import to both developed and emerging nations alike. Smallbone, an irrepressible personality who disliked the second rate, could always be relied on for new ideas on how to promote and improve the status of IIW. He was often heard to say that success came from two attributes, 'enthusiasm and persistence'. A keen believer in technology diffusion, Smallbone was also the driving force behind IIW International Congresses which had been held since 1988 and provided nations in emerging regions with a means of becoming acquainted with the benefits that membership of IIW could bring.

Apart from promoting appropriate welding technologies, Congresses brought together people from industry, government and training bodies to share ideas on how the improvement of welding in the region could lead to raising the general quality of life of people through the IIW WeldCare programme. These events, hosted by Member Societies for their regions, proved to have a positive impact in attracting new members to IIW. Membership increased significantly from what was a static level of around 38-40 Member Countries over the previous 10 years, many unfinancial, to a total of 48 members in 2005.

The development of standards, as well as IIW's relationship with ISO, continued to be in the spotlight in the late 1990s. IIW received strong criticism from the floor when Mr H-J Krause, the national delegate for Germany, and others, expressed disappointment with the output of the standardisation work in IIW at the second General Assembly in San Francisco in 1997.[20] Krause was a member of the highly influential CEN Technical Committee 121 *Welding and Allied Processes* (CEN/TC 121) and also a prominent member of IIW's Commission III *Resistance Welding and Related Processes* (C-III). Hicks, naturally, was

quick to refute these suggestions as he had been working hard to address such issues in the short time he had been the IIW Standardisation Officer. He had also gone to great lengths, along with Bramat, to improve the situation through a meeting with ISO held in Geneva six weeks earlier.[21] The implications arising from the strength of Hicks' response were to involve considerable discussion between members of the Board of Directors and, as a result, Ziegenfuss eventually replaced Hicks when Hicks retired from this position at the end of 1998. Braithwaite commented on this change, stating it '…was a very positive move since nobody knew more about standards and their difficulties than Dr Ziegenfuss'.[22] Ziegenfuss was to have a productive meeting with Hicks and was confident that the transition between the two would go very well.

Ziegenfuss was a details man and brought about many procedural changes that improved relationships with ISO and other standards authorities. Importantly, he was able to work closely with all the respective IIW Working Units by providing a conduit through which emerging standards could see the light of day. He was the first non-European observer to any CEN committee in the late 1980s, as an ISO/TC 44 *Welding and Allied Processes* representative, and his views were often solicited during meetings. He had a high regard for Mr Birger Hanson (Denmark), who was Chair of CEN/TC 121 for an unprecedented five three-year terms from the late 1980s to the early 2000s. Ziegenfuss recollected that Hanson was an excellent chair during times of raucous and heated debate in the committee over many of the mandated standards being developed in Europe.[23]



*Jan Pilarczyk*

The work of the IIW Standardisation Officer and the Secretariat was to bring rewards from other quarters when it culminated in an agreement with ISO in June 2001 for a payment of CHF 1 000 for each standard prepared by IIW and published to date by ISO. This was a move that added to financial stability in a year where the possibility of expense on the qualification and certification scheme was coming under consideration.

One other important change in IIW operations took place in 2001 when the General Assembly, held at Ljubljana, Slovenia, was informed that this was the last time that two General Assembly meetings would be held during each IIW Annual Assembly, thus putting an end to an era lasting since 1948.[24] In the context of the structural reorganisation of IIW, a Technical Management Board (TMB) was set up in 2002 to replace the Technical Committee with added responsibility for the general policy and objectives of all IIW's scientific and technical activities and their role in producing standards. Initially, the TMB consisted of 11 members with Prof. Dr-Ing. Ulrich Dilthey (Germany) as Chair. Also, within the

structure of IIW, the Select Committee *Standardisation* (SC-STAND) was to play a valuable role in the organisation of IIW's standardisation programme through maintaining links between the IIW Secretariat, the ISO Central Secretariat, and the principal ISO Technical Committee on welding, ISO/TC 44. As mentioned, IIW was one of the first organisations to be approved by ISO to prepare draft standards and submit them for voting without having a peer review by ISO working units. Dr David Shackleton (UK), who then became Chair of the SC-STAND, was known to be a proud supporter of publishing technical documents in addition to conventional standards.

Time was marching on for the Secretariat, as it was for everyone else. The term of the French Institut de Soudure's contract as Secretariat for IIW was due to expire in 2000 amid some expectation that the Secretariat's performance could be improved markedly.[25] A Board of Directors Task Group (TG-SEC) was therefore formed, consisting of Braithwaite as Chair, plus group members, Pekkari, Smallbone and Reynolds and Prof. Jan Pilarczyk (Poland) IIW Vice President, with Prof. Lin Wu (China) added later. The Task Group gave preliminary consideration to proposals from interested Member Societies at its inaugural meeting in Villepinte in January 2000. The group then met again during the American Welding Society (AWS) National Convention in Chicago on 26 April 2000. The purpose of this meeting was not only to review the proposals from the respective organisations but also to interview representatives of each of the organisations that had submitted bids. Included among the interviewees was Mr Daniel Beaufils representing the Institut de Soudure.

*Presentation to Daniel Beaufils by the IIW Board of Directors, including four Past Presidents and three IIW CEOs, in Paris, February 2008*

Beaufils had an excellent background in welding and a distinguished period of service over many years with the Institut de Soudure. He recalled later that he was very surprised when Mr Viré, former head of Institut de Soudure, offered him the position of CEO should the Institut become successful in winning the contract. In making the offer, Viré explained some of the difficulties encountered and what the expectations of some countries were.[26] During the actual interview Braithwaite explained to Beaufils that the French IIW Secretariat had not performed up to expectations and that this had led the IIW Board of Directors to look for new candidates. Beaufils remembered being very impressed by the interview itself but was equally certain that he would not get the job.[27]

*Daniel Beaufils*

Following the interviews a long discussion took place on the merits of the presentations. After much debate Pilarczyk, like others on the task force, was asked what his views were. After some consideration he said 'Daniel as the new CEO and the Secretariat in Paris again'.[28] It was the unanimous decision of the Task Group that the next five-year term, starting 1 January 2001, should be awarded to the French Institut de Soudure with Beaufils as CEO, pending approval by the General Assembly in Florence, Italy the following July.

In recognition of Bramat's efforts a presentation was made to him on behalf of everyone at IIW at the Florence General Assembly. Bramat, who had been involved continuously with IIW for almost 30 years, responded by saying that '…it was one of the most enjoyable jobs he had ever done in his professional career'.[29]

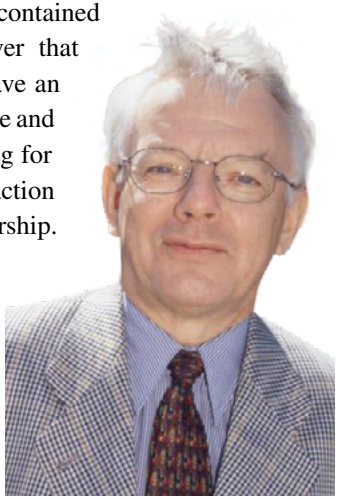
Beaufils showed quick initiative by moving to improve the operations of the Secretariat through the acquisition of new computing equipment, implementation of new software, upgrading of the database for searching IIW documents and improvements to the new website. Beaufils also made changes to the staff of the IIW Secretariat and invited Ms Noëlle Fauriol to take on the position of IIW Scientific and Technical Officer with the responsibility for *Welding in the World* and the IIW database. Beaufils was most impressed by Fauriol's standing within IIW and her ability to speak five languages.[30]

*Noëlle Fauriol*

Beaufils was also impressed with the previous work of Ziegenfuss as the Standardisation Officer. During a CEN/TC 121 meeting in Copenhagen he offered the position in the new Secretariat to Ziegenfuss, a little hesitantly he recalled, since he might receive a negative reply. Ziegenfuss dispelled any concerns that Beaufils may have had by saying '…we have been competitors [for CEO] but now that the bidding process is over I have great pleasure in accepting your proposal and to serve IIW'. The 'dream team' as Beaufils was to call it, was ready for action and he then advised Braithwaite of his team structure and his action plans for the future.[31]

Braithwaite himself was impressed with the level of turn-around that eventually did take place and later was to congratulate the new CEO on the improvement to the Institute's operations. Beaufils was clearly delighted with one of the more notable achievements the Secretariat had made during the first years that he had been the CEO. He was to underline, in purple prose, that the IIW accounts for 2000, 2001 and 2002 had been the subject of a tax audit by the French fiscal authorities. The conclusion was a rather pleasing – 'No tax penalty'.[32] The position of CEO, though, was not without its frustrations and continued demands by successive Presidents often meant that Beaufils had to put in long days, including weekends, to ensure that such entreaties were satisfied.

Beaufils was to introduce the first IIW Annual Report on the activities of the IIW Secretariat and the Board of Directors in 2003, including a detailed assessment of the Institute's accomplishments and technical output over the previous 12 months. This was a talking point for members since it contained all the necessary information on IIW's performance over that year, including its financial and budgetary status. It did have an immediate impact since its commentary was both informative and interesting, something that the membership had been calling for and expecting for some time. The worthwhile nature of this action was to engender a feeling of satisfaction within the membership. The 'ship of state' was being managed in a professional way and in the best interests of IIW members.



*Bertil Pekkari*

Pekkari, on assuming the Presidency in 2002, was a senior executive from industry who also saw revitalising IIW as one of his key actions over the next three years. The principal drawcard now, in attracting future members, was the chance to participate in the IAB qualification scheme and for Member Countries to

provide opportunities for global recognition to their professional and welding personnel. Without question, the IAB's education, training, qualification and certification scheme was the 'jewel in the crown' as far as IIW was concerned. It had grown at an unprecedented rate and this growth had extended to a network consisting of 35 active and interested countries over the scheme's first five years.[33]

Like Braithwaite, who stabilised IIW's financial situation, Smallbone's efforts on regional activities and input into the qualification and certification scheme were instrumental in him being elected as IIW's next President following Pekkari's successful presidential term that ended in 2005. Smallbone epitomised the essential difference between leadership and management – vision. In many ways his appointment was to herald a new dawn for IIW and with it a different way of thinking that would test the more conservative values of the past. Some of the initiatives, indeed, consisted of new values, including proposals to 'improve the global quality of life by the optimum use of welding technology'[34] and a guiding vision through the TMB to 'identify and develop and create world best practices'.[35]

Both these missives were to underline a major change in the way that IIW was about to see itself in a world that was now becoming a place where the social, political and the scientific landscape would move faster than it had ever done before. Philosophical meandering had no place in this new order. It was a time for pragmatism, professionalism and a continual process of renewal to keep IIW relevant. It was a world that presumed a new consensus, a shared agenda and a global partnership to achieve its objectives.[36]

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chapter 3

# the art of governance

**"Nil satis nisi optimum – Only the best is good enough"**

*Mr Chris Smallbone, IIW President 2005-2008*

*Traditional handover of the IIW flag from Japan to the Czech Republic, organisers of the IIW Annual Assembly to be held in Prague in 2005*

IF THE TECHNICAL MANAGEMENT BOARD (TMB) AND ITS RESPECTIVE Working Units were the backbone of IIW, and its qualification scheme was its very soul, then at the heart of IIW's success was the way it was governed. Governance is a broad-ranging term encompassing the rules, relationships, policies, systems and processes whereby authority within an organisation is exercised and maintained. Good governance is about the processes for making and implementing decisions and therefore is accountable, transparent, equitable, inclusive, responsible, participatory, ethical and follows the rule of law.[1] The art of governance not only meets all of these criteria but also involves the incorporation of strategies related to inclusiveness such as equality, opportunity, rewards, recognition for outstanding service, and the opportunity for social interaction at IIW Annual Assembly and Working Unit meetings.

IIW's early business/strategic planning process, in the 1990s, was mainly to solve the issues of the day and did not really focus on where the Institute was heading and how it was going to get there. Business planning within IIW has since become more professional in its design and in the way collective leadership could achieve its goals on issues of direct importance to the Institute. Following the completion of a new Constitution and the adoption of the final draft of IIW's Bye-Laws in 1997, a 'visioning' workshop was held in late 1997 to examine the ways and means of developing a new business plan for IIW.

Elements of the IIW Business Plan were discussed in Hamburg, Germany in May 1998 but it was evident that considerable work was required before it was considered to be complete.[2] Mr Bevan Braithwaite assisted Mr Michel Bramat and the Secretariat in this process and, by the time of the forthcoming Annual Assembly meeting in Hamburg, Germany in September 1998, the Business Plan had been circulated to Member Societies, Commissions and other Working Units for input and was unanimously adopted at this Assembly.[3] A total of 22 strategies were included in the Business Plan on such aspects as relationships with ISO, creation of a new website, communications, environment, health and safety, the qualification scheme, and many other matters of importance to IIW.

At the outset, the contents of the Business Plan were considered to be too ambitious and would require considerable resources for the plan to be implemented and monitored in

a meaningful way, much of the burden being carried by the IIW Secretariat. In light of this, the Board of Directors approved 11 strategies of the Business Plan for implementation in the first 18 months, to achieve IIW's objectives towards one of its goals, 'to promote IIW and its Member Societies and services in various regions of the world to the mutual benefit of all'. The persistence of Mr Chris Smallbone (Australia) in trying to get regional activities into the Business Plan was finally rewarded when this was included, in principle, with a later amendment to the plan and presented at the Annual Assembly in Lisbon, Portugal, in July 1999; an action that required the WG *Regional Activities* (WG-RA) to produce the elements of its own business planning for review and approval before finalisation.[4]

The IIW Business Plan, initially, was predicated on a short time frame in which amendments to the plan and analysis of its progress were reviewed over a 12 month period, which was specifically tailored to suit meetings of the Board of Directors and the General Assembly. It did commence in an official capacity after the Lisbon meeting in January 1999 and the first progress review of any description occurred at the General Assembly meeting in Florence on 14 July 2000, where specific presentations on various aspects of the Business Plan were given, including contributions on the environment by Mr Bertil Pekkari (Sweden) and on regional activities by Smallbone.

The general consensus regarding the Business Plan was positive overall and four important resolutions were approved by the General Assembly that reflected the growing importance of IIW activities outside of the traditional Europe and North America.[5] These were that:

- IIW develop a brand name for the products and services offered to potential countries;
- the IIW IAB and WG-RA link in their key strategies on the promotion of the IIW qualification programmes throughout the regions of the world, particularly developing countries;
- regional activities be incorporated in all activities of the Business Plan;
- all willing IIW Member Societies administer agreed activities of the IIW WG-RA in a region of the world on a voluntary basis.

These resolutions would eventually provide the foundation for the success of many of IIW's objectives in the years to come. The Business Plan, to be enacted over the years 2001-2005, was to proceed on the basis of a continual review process with incremental changes made as a result. In common with the Business Plan, revisions of the Institute's Bye-Laws and Constitution were also carried out for the first time since those documents were introduced after the transition to a single Secretariat in 1995. Dr Martin Prager (USA) was to play a prominent role in the drafting and wording of the Constitution and Bye-Laws.

In addition to his attributes as a skilled wordsmith, Prager became an outstanding Chair of Commission XI *Pressure Vessels, Boilers and Pipelines* (C-XI) with its principal role regarding the design, fabrication, life prediction and failure prevention of pressure vessel components and pipelines.

*Martin Prager*

Dr Richard Dolby (UK), Chair of the Technical Committee was also to propose new rules for the composition of that committee including changes to Working Unit categories.[6] Ultimately this led to a name change for the Technical Committee to Technical Management Board (TMB), which was enacted in 2002.

Changes to the Constitution and the Bye-Laws did highlight the difference in interpretation between the English and French versions of the Constitution. This precipitated one of those rare events, an Extraordinary Meeting of the General Assembly in Copenhagen, on 23 June 2001, to approve resolutions to prepare a French version of the Constitution for registration by the French Authorities and an English version for distribution to Member Societies.[7]

The Business Plan served for a period of approximately 5 years. As a consequence of change, and the successful achievement of several important objectives, the Board of Directors was in agreement to review and update the Business Plan in July 2005. Constructive feedback from a meeting of the Chairs of Working Units in January 2006, though positive overall, considered that the current plan did not communicate effectively with the Working Units therefore it was recommended that all IIW technical and administrative units be involved in the planning and execution of the new Business Plan.

As President of IIW 2005-2008, Smallbone was to seize the opportunity to take strategic planning to a new level with the development of a comprehensive five year Business Plan from 2007-2012. The new plan took into account the comments of the Working Units and was constructed from the building blocks of a number of strategic plans developed by every administrative and technical group within IIW.

This was important since it granted ownership of the plan to all those who were involved in the business planning cycle. The objective of the Business Plan was for it to function as a working document and act as a roadmap for all the respective groups of IIW. Its purpose was to demonstrate to all stakeholders, including the membership at large, what the role of IIW was, including its future direction and initiatives around the world.[8]

*Traditional Opening Ceremony with a cultural display at the IIW Annual Assembly, Japan, 2004*

The five goals of the Institute as stated in the 2007-2012 Business Plan were to:

- identify, create, develop and transfer the best practices for sustainable development in a sustainable environment;
- identify, develop and implement the IIW Education, Training, Qualification and Certification programmes on a global basis;
- promote the IIW and its Member Countries in all regions of the world to the mutual benefit of all;
- assist in the implementation of IIW's outcomes;
- provide quality services to IIW, IIW Member Societies and other organisations.

The principal aim of the structure of this Business Plan was to integrate the five main Working Units of IIW into the strategic planning process. These were respectively the TMB, the IAB, the WG-RA, the Board of Directors Working Group *Communications and Marketing* (WG-COM&MARK, formerly WG *Publications*) and the IIW Secretariat. Each of these Working Units had four objectives to be realised before achieving their goal. Technical Working Units such as Commissions, Select Committees and Study Groups, having their own goals and key objectives, were to report to, and support the goal of, the TMB.[9] Similarly, the goals and key objectives of some Working Units were supporting the goal of the IAB. In this way the whole process of planning was integrated closely in a holistic manner to achieve the best possible results for IIW. The inclusion of the Business Plan in the 2007 Annual Report, therefore, was an excellent means of engaging the global welding community and its stakeholders in a transparent and open way that would inspire confidence and trust in the way that IIW was governing its business.

While not losing sight of the importance of the business planning cycle, emphasis on this alone could be wearisome and detract from the well-being of what membership of IIW was all about. The antithesis to the cold, hard facts of planning the business were the Annual Assemblies, International Congresses and International Conferences which, in many ways, were the lifeblood of the Institute and were where the trappings of governance became most apparent to the membership. Friendships had been built up over numerous years through the Annual Assemblies and the work of the Commissions, developing common bonds between members in the best traditions of 'liberté, égalité, and fraternité'.

The 60th Annual Assembly, held jointly in Dubrovnik and Cavtat, Croatia, in 2007, epitomised the success of holding meetings of this nature. This Assembly was a meeting of minds, if one might call it that, when 850 participants, including partners and non-members, attended from 45 different countries. The engine rooms of the Institute, clearly, were the technical Working Units – the Commissions, Study Groups and Select Committees which met in full at these Annual Assemblies, and at other meetings throughout the year. Such meetings contributed significantly to the camaraderie and harmony that pervaded within IIW as a result of common endeavours. Even after a long day of presentations, discussions, and the thrashing out of many resolutions and recommendations for standards, the combined effect of this was a rewarding experience in itself. Mrs J. Fernandez-Ballesteros (Spain), in 1991 the first female representative member elected as Vice-President on the Executive Committee, encapsulated this by saying that '…the cold, lifeless exchange of technical information has been made more effective by personal contact amongst those working in the same countries'. She added further, 'This has created a greater understanding and has without doubt meant a significant step forward, not only in technical progress, but also in mutual respect between all who work in the welding sector around the world.'[10]

Meetings, therefore, had their moments and sometimes the elements would conspire against attendees and no better example can be given than when a terrible snowstorm kept everyone captive at the International Congress Centre at Stara Lesna, Slovakia, in late October 2009, working studiously until the blizzard finally abated.[11]

A year earlier in Graz, Austria, even torrential rain could not dampen spirits at a memorable Austrian evening at Kasermatten-Schlossberg. The late arrivals (due to the rain) prospered most when they were placed in a dry restaurant with panoramic views.[12] In keeping with Austria's Mozart connections the opening ceremony of the Assembly was followed by excerpts from *The Magic Flute*, performed by the orchestra and singers of

*Delegates at the first IIW International Congress for Central Europe were snowbound in Stara Lesna, Slovakia*

the University of Music and Dramatic Arts of Graz. As part of the fabric and the art of IIW life, all Assemblies and Congresses would feature national presentations of song and dance which engendered local ambiance, and a feeling of belonging and being a part of a global network of like-minded persons. Apart from the business of planning and the routine running of IIW, from a governance point of view, the networking and social side of the Institute was the very substance that sustained it through good times and bad.

In recognition of such efforts by many of its members, often on a voluntary basis, IIW initiated a new awards system for recognition of their contributions through attendance at Annual Assemblies. This took the form of lapel badges and certificates of citation for attendances of over 30 years, 20 years and 10 years, with the first recipient for 30 years going to Dr Norman Eaton (Canada) at the Quebec Annual Assembly in 2006. In consideration of Eaton's other contributions, it was recalled he was 'The initiator of the awareness that an organisation must change its approach; first of all from an organisational point of view to reach efficiency and financial sufficiency; but also by setting objectives and adapting itself to result oriented objectives.'[13]

*Norman Eaton (right) receiving his 30-year IIW Recognition Award at the Quebec Annual Assembly in 2006 from Chris Smallbone*

The concept for such awards came up first at the Annual Assembly in Prague, Czech Republic, in 2005. Dr Krishna Verma (USA), Principal Engineer of the US Department of Transportation, made mention during a break in proceedings that IIW should introduce some kind of recognition for the many participants in the IIW Working Units.[14] Arising from these discussions were suggestions that attendances at Annual Assembly meetings be recognised, not only from a personal point of view, but also to provide confirmation with employers that tangible benefits were being achieved as a result. It was considered that the presentation of an award or a lapel badge was one way of recognising, as a mark of appreciation, regular attendance at future IIW Assemblies. Party to these discussions was Smallbone, at that stage the President-Elect of IIW, who offered to put the matter of awards to the Board of Directors. It was then approved unanimously and in 2006 these awards became a permanent feature of Annual Assemblies. The first gold lapel badges to be awarded on this occasion were through the courtesy of the Welding Technology Institute of Australia (WTIA). A total of 32 awards for 10 years, 18 for 20 years and five awards for 30 years were presented by the President to those that attended the Assembly including that of Eaton.[15] The awards, fittingly, were accompanied by framed certificates of appreciation outlining the recipient's individual contribution to IIW.

Another recipient, Dr Damian Kotecki (USA), also received a 30-year attendance award two years later in 2008. At the same time the receipt of a 'piggy bank' on being elected as Treasurer of IIW was another source of amusement which brought a smile to Kotecki's bewhiskered features when the previous Treasurer, Prof. Dr-Ing. Detlef von Hofe (Germany), passed on the trappings of succession. On leaving finance in Kotecki's capable hands, von Hofe was to report a very healthy situation with respect to finance '…the IIW's finances have been very solid for many years and the slight decrease in running costs in relation to the year 2008 was due to very cost-effective measures of the IIW Secretariat and the postponement of promotional activities for the IIW and the IAB'.[16] Like everyone else, Kotecki would not have been aware that the Global Financial Crisis (GFC) was only just around the corner when he took on the position of Treasurer.

*Damian Kotecki, as incoming Treasurer, receiving 'piggy bank' from Detlef von Hofe*

In the context of IIW's challenge in the Business Plan, to increase representation

from developing countries, International Congresses in different regions were to feature prominently over the period from 2006-2010, creating great interest by the nations in these regions in the benefits of becoming a member of IIW. Some of these new members, including Nigeria (2006), Tunisia (2007) and Morocco (2009), were to increase significantly the representation from the African continent, while the Republic of Korea (South Korea) (2007), Turkey (2008) and Lithuania (2008) strengthened IIW's bloodlines even further, making it truly representative of the world at large.

Despite the GFC, the three years from 2008 to 2010 were most productive in producing highly successful International Congresses, with three in 2008 including Tianjin in China, two in 2009 including Ajuba in Nigeria, and four in 2010, with Hammamet in Tunisia being one of the more exotic places for such a Congress to take place. To further stimulate interest in Middle Eastern countries, IIW also supported a successful conference in Damascus, Syria, entitled *Development of Welding Technology in the Arab World* in January 2009 unaware that the dawn of the 'Arab Spring' was not too far away. The 'Arab Spring' did, in fact, lead to Tunisia suspending its membership of the IAB temporarily in 2011 and the IIW membership of Libya becoming increasingly uncertain in the same year.

One of the important aspects in attracting new members and the promotion of the benefits of IIW was the development and implementation of the 'WeldCare' programme by WG-RA in 1996. The programme, utilising the knowledge and experience of WG members, supported technology diffusion and training in developing countries, including the promotion and support of networks of national and regional Technology Support and Education and Training Support Centres. The growth of the South Eastern European Network (SEENet)

for instance saw extensive cooperation between its members and the establishment of centres of technical excellence throughout the region.

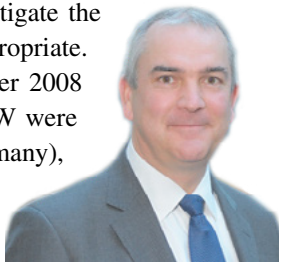
*Anne Rorke*

A prime thrust of IIW was to repeat this throughout the world, most notably in Africa, Pan-America, South America and South East Asia. Ms Anne Rorke (Australia), Chair of WG-RA 2005-2008, was to put the importance of technology diffusion in simple but understandable terms, '…a technology that may be considered "old hat" in Europe or the USA could dramatically improve the quality of welding, productivity and welder safety in developing nations'.[17] That, essentially, was what IIW and WG-RA was all about – playing a pivotal role in improving the global quality of life by the optimum use of welding technology, as well as providing the networks through which this could be achieved.

From another perspective, recognition of skills, IIW signed a Memorandum of Understanding (MOU) with WorldSkills International in 2006. WorldSkills competitions at all levels provided a means by which young people involved in vocational welding training could display their skills and consequently improved the image of welding as a career. The practical application of the MOU was put in place through the Japanese Welding Society, an IIW Member Society, at the International WorldSkills competition held in Shizuoko, Japan, where over 290 000 visitors from around the world had access to the competition for young welders.[18] This formula for cooperation between Member Societies and WorldSkills was repeated just as successfully in Canada in 2009 and London in 2011, again attracting large audiences.

IIW had weathered the storm of the GFC exceptionally well and, apart from a fall in reserves due to the development of the website in 2009, the financial position was positive in all respects. In keeping with this turn of events it was noted that, after the 2008/9 downturn, the world's economy was now expanding industrial demand for welding and joining products.[19]

In anticipation of structural and other changes to IIW, with respect to its Constitution and the way it was governed, the IIW Board of Directors, at its meeting in July 2008, appointed a Task Group *Governance* (TG-GOV) to investigate the present governance situation of IIW and make changes where appropriate. The first meeting was held at the Institut de Soudure in October 2008 with Smallbone as its first Chair. Several senior members of IIW were present including von Hofe, Prof. Dr-Eng. Ulrich Dilthey (Germany), TMB Chair Dr Christoph Weisner (UK), IAB Chair Mr Germán Hernandez (Spain), Prof. Dr-Ing. Luisa Quintino (ISQ/EWF-Portugal) and a French lawyer, Mr Jean Claude Genevois, who led the discussion on the legal aspects of governance.

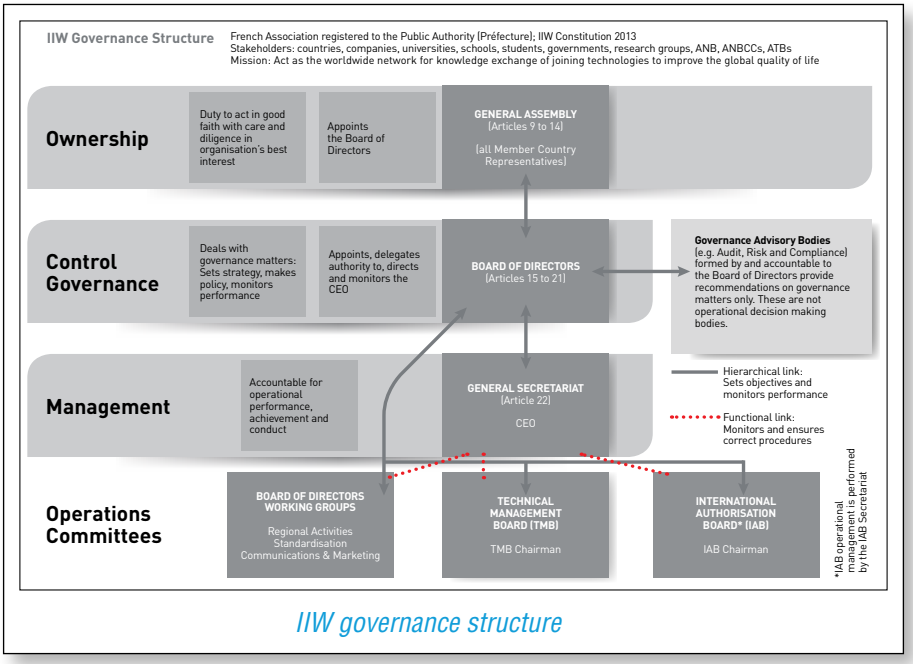


*Christoph Weisner*

The meeting was arranged by Mr André Charbonnier who had taken up the role of CEO of the IIW Secretariat on the retirement of Mr Daniel Beaufils in February 2008. Charbonnier had held a senior position in the Institut de Soudure and was to work closely with the IIW President, in particular assisting Member Countries to implement the IIW Manufacturer Certification Scheme. Within a year, Charbonnier was offered another very senior position within the French institute and unfortunately resigned from the IIW Secretariat to take up this new role. The position of IIW CEO was then filled by Dr-Ing. Cécile Mayer in 2009. She had been working as Manager International Standardization at the Institut de Soudure, responsible for the strategic orientation of the standardisation programme and representing France during meetings, as well as successfully chairing the IIW WG-COM&MARK since 2005.

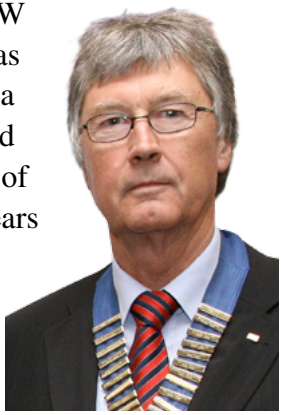
The discussions at the TG-GOV, given the people attending the meeting, did centre on governance with respect to IAB issues and the operation of the IIW/EWF scheme. In the closing stages of the discussion, von Hofe did ask a pertinent question that was difficult to foresee. 'If there is competition between IIW and one of its members, or between ANBs, is it a legal issue or an internal one?'[20]

The initial work of TG-GOV was to establish a draft governance manual in line with the French Governance Association Scheme, including the structure, manual, and the terms




*IIW governance structure*

of reference for IIW's TMB, Board of Directors and IAB as well as separate proposals for a licence agreement between IIW and EWF. Inevitably progress was slow due to the detail of this work and the exacting requirements in the revision of IIW's Constitution. This was progressed after some delay through a workshop in 2013 with the assistance of two French consultants from ABAQ Consulting who provided a high level of expertise in the preparation of a constitutional model to meet the requirements of the French authorities.[21] The workshop was attended by members of the Board of Directors and the Chair of TG-GOV and covered a number of issues such as insurance, legal liability, taxation, vocabulary, bye-laws, risk management, roles of officers, responsibilities and limitations of the CEO.[22] This workshop, as intended, was to have a galvanising effect with respect to the on-going work of TG-GOV and a new version of the Constitution and Bye-Laws was approved by the Board of Directors at its meeting in Essen, Germany on the 11 September 2013 after amendments from the Governance Workshop had been made.



*Ulrich Dilthey*

In 2008 Dilthey succeeded Smallbone as IIW President. Consistent with German tradition he was well versed in the operations of IIW and, having a strong ceremonial bearing, he was typically measured in the way he went about conducting the business of the Institute after the great leap forward in the years 2005-2008. In discussing the way ahead he said in his opening address as President, 'It is my sincere belief that the upcoming years should be dedicated to consolidation of all that has been achieved so far'.[23] Much was achieved during Dilthey's term of office due to the outstanding achievements of many within IIW, including substantial improvements to the interactive website and the complete integration and harmonisation of the IIW qualification and certification scheme, which provided Member Societies with a profitable business platform to work from.

As part of IIW's attendance recognition system, Dilthey became the first recipient of an award for attending 40 years of Annual Assemblies on his retirement from the position of President of IIW. Prof. Pavel Stular (Slovenia) did in fact achieve this milestone earlier and had attended a total of 49 Annual Assemblies but, unfortunately, passed away suddenly in 2007 before the award could be presented to him.[24] Earlier,

at the IIW Annual Assembly in 2005, in Prague, Czech Republic, it was therefore a fitting tribute that Stular received the Arthur Smith Award for dedicated service to IIW over many years. With respect to other awards for service, IIW also introduced Service Recognition Awards for the Chairs of IIW's Working Units who had a minimum of 5-years' service in those capacities. Among those who had achieved recognition for their services in 2011 were Mr Vincent van der Mee (The Netherlands – (Commission II) and Mr Ernest D. Levert (USA – Commission IV), whose services were very much appreciated. A special token of gratitude was presented to Dipl.-Ing. Dietmar Rippegather (Germany) in recognition of three consecutive three-year terms and meritorious service in a 'difficult and challenging role' as the Chair of Commission VI *Terminology* (C-VI).[25]

*Dietmar Rippegather*

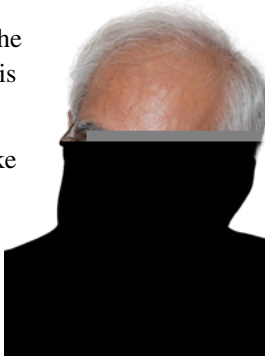
The issue of membership fees was never far from the minds of a number of delegates at the Annual Assembly in Singapore in 2009 and a request was made for serious consideration of an alternative method for the calculation of membership fees. A Task Group *Fees* (TG-FEES) was therefore set up under the chairmanship of Dr Daniel Almeida (Brazil).

Almeida was to progress this project quite diligently until exceptional circumstances prevailed that prevented his attendance at meetings in 2012. During a burglary attempt on his home in 2011 he was shot in the spine. As Almeida explained, 'It was really a miracle, in truth, two miracles – one that I am here and two that I can walk. I could only stand up 30 days after surgery. In the beginning I was totally paralysed, even my fingers would not move. After therapy I started to use a pencil but my signature had changed and I had problems with my bank and notary'.[26]

TG-FEES proposal was initially put to the Board of Directors via the President at its meeting on 8 July 2012 at the Denver, USA Annual Assembly. The proposal was based on a formula that included both steel consumption averaged over three years, capped, plus a percentage of the Gross Domestic Product (GDP), also capped.[27] The proposal was accepted by the Board but was subsequently rejected by the members at the General Assembly, which resulted in a request to all Member Societies to submit their proposals for the calculation of fees with only three Member Societies responding. Almeida expressed disappointment at this and developed a real urge to complete unfinished business through the assistance of Mayer, CEO of IIW, '…Cécile and I worked a great deal to create a new calculation for the IIW annual fee. We had a chance to get

*Daniel Almeida*

approval by the Assembly but as some countries didn't agree so the President decided to postpone the decision – that was a pity. It is almost impossible to get 100% of the votes.'[28]



Baldev Raj

It now fell on the shoulders of Dr Baldev Raj (India) to take over the duties of IIW President for the subsequent three-year period from 2011-2014, while Dilthey assumed the duties of the Chair of the IAB. Raj was quite different to Dilthey in his approach to his role. He viewed things from a more holistic point of view and had a wonderful way in his elaboration of the English language, whether spoken or by the written word. Coming from a developing country and being the first President of IIW from India, he was a fervent supporter of regional activities and IIW's mission to improve the global quality of life. His comments in his opening statement on becoming President matched this belief. 'In order for the planet Earth to remain a viable and blissful habitat for humanity, there must be less disparity amongst her citizens in terms of quality of life, stability of societies, and true sustainability must be realised.'[29] Such vision equated to IIW's stated mission, 'To act as the worldwide network for knowledge exchange of welding technologies to improve the global quality of life'.

Whether or not this was meant to signal a more idyllic pace for IIW, his words were quickly overtaken by an earthly passion to quicken the pace of reform. It seems that Raj's words were more an expression of the consciousness of the human state and good karma to accompany the Institute on its travels through a multitude of causes and objectives.

The Institute by now had developed a forward way of thinking and a new edition of the Business Plan for the period 2013-2017, mentioned earlier, was subsequently adopted by the General Assembly in September 2013. In concert with the Business Plan, governance structure was reinforced to facilitate maximum transparency for IIW and its stakeholders based on sound principles, to act in good faith, with care and diligence, and in the organisation's best interest.[30] The new IIW Constitution, after being in place for one year, clearly defined Member Societies as possessing the ultimate decision-making authority in the IIW organisation. Raj was to reinforce this change in attitude by saying that the new governance structure created effectiveness through openness, transparency, accountability and integrity.[31] Ultimately this was to lead to the publication of a brochure on IIW's website titled *IIW Values* detailing the ethos and guiding principles of the International Institute of Welding.[32]

Gary Marquis

a spirit of cooperation, which is rarely paralleled in technical societies.'[35] Governance in all of these respects would be ever important in the Institute achieving confidence and stability for all its members in the critical period that lay ahead.

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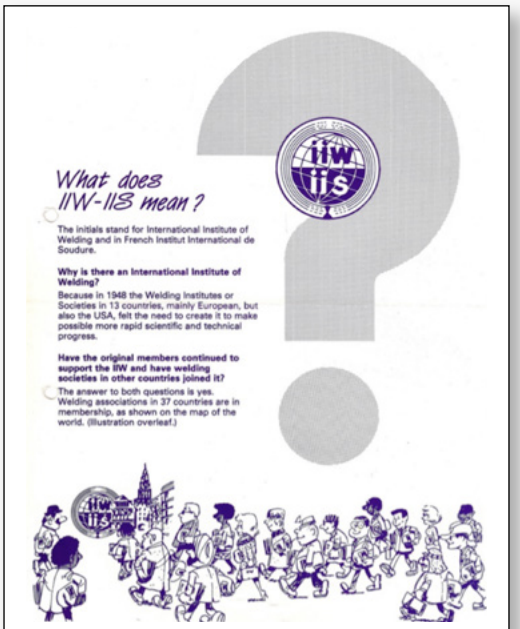
# foundations for successful communication

chapter 4

**“. . . but these changing times do not allow us to become complacent”**

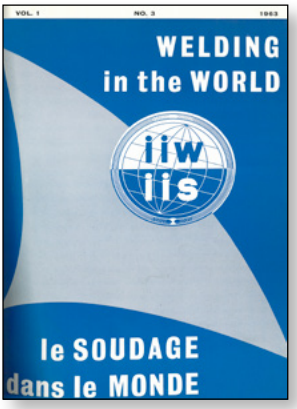
*Dr Baldev Raj, IIW President 2011-2014*




*IIW promotional brochure prepared after the 1988 Annual Assembly*

THE MEANS OF COMMUNICATION TAKES MANY FORMS. IT CAN BE in the written sense or it can be verbal. It can be in the form of documentation or it can be as a result of seminars, or similar gatherings, or it can be accessed through electronic and social media such as messaging and websites, or by visual means through media presentations and the like. There are numerous means of communication that cover the full spectrum of activities that are involved in the running of a worldwide organisation such as IIW.

From its very beginning, the IIW Secretariat was the central hub around which all communication systems emanated and gradually it became the source of all aggregated information coming from the activities of the IIW Working Units. Clearly, the Secretariat served as the repository for exchange of information and knowledge on all things pertaining to welding and its associated activities.

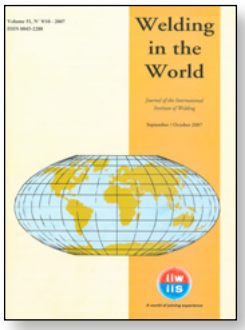



The foundation for effective communication was initially well recognised by Mr Guy Parsloe (UK), Secretary General of IIW 1948-1966. Being an historian he was particularly interested in the dissemination of information and a strong advocate of the Institute's involvement in documentation and terminology, which attracted little support from the majority of engineers.[1] The means of communication was quite ponderous in these early years and was dependent to a large extent on a process of typing and copying, then the distribution of documents by hand or through a slow and sometimes unreliable mailing system. Great emphasis was placed on verbal reports by the Chair of Commissions. These reports were not recorded or translated into official documents.

To ensure the Commissions were not working in isolation, the practice of circulating minutes to Chairs of other Commissions commenced in 1951, eventually leading to the start of regular meetings of Commission Chairs in March 1953 for the purpose of discussing matters of mutual interest. The main reason for convening such meetings was to achieve the 'harmonious execution of complex work programmes for all Commissions'. Parsloe was influential in producing the first Annual Report of the Executive Council and Secretariat

in 1953, five years after the Institute was founded. He also established a policy whereby Member Societies had the opportunity to act as publishers of IIW books of particular interest to them. Parsloe's involvement in publishing and documenting work continued when he became the joint editor in chief of *Welding in the World* (WiW) when it was first published in 1962.[2] The journal was bilingual, both English and French, with Mr André Leroy of the French Institut de Soudure contributing equally as the publication coordinator. From a wider perspective IIW did take a lead later in publishing important stand-alone documents such as *Guidance on Fitness for Purpose*, the first comprehensive and truly international guidance document on this topic, which was issued in 1992.[3]

The introduction of WiW by IIW was to promote and disseminate state-of-the-art reports of IIW's Commissions that were fundamental in advancing the science of welding and joining, covering technology, health and safety, education and training, all of which were important in the technical progress of both developed and developing nations. The content of WiW, primarily, consisted of selected papers presented at Working Group meetings which had been approved by Working Groups for publication. These papers were then edited by the Secretariat for inclusion in the journal.[4] IIW benefited substantially from the sales of WiW as a result and, in order to increase sales further, it was decided at the 1983 Annual Assembly held in Trondheim, Norway not to publish in-house but to engage Pergamon Press to take over publication of the journal.




In 1992 Pergamon Press was bought out by another academic publisher, Elsevier, which continued publishing WiW until 1998 when they were to inform IIW that they would no longer be publishing IIW's journal. This may have been due in part to the fact that IIW had squeezed extra royalties out of an agreement with Elsevier a few years earlier in 1996. Nevertheless, it was an interesting turn of events since, earlier that year, Mr David Reynolds (Canada) had suggested that other means of producing the journal should be considered, including electronic publishing on IIW's website or distribution as CD-ROMs. Some debate ensued at the Technical Committee on the merits of doing so but it was eventually decided to continue with the printed version, mainly because of the credibility and visibility that it provided for IIW, as well as being a source of citation for other authoritative documents or scientific papers.[5] In this respect Working Group *Publications* had also discussed with Elsevier, in 1997, the conditions for inclusion in a citation index. These discussions, evidently, didn't achieve any finality due to Elsevier's declining interest in publishing WiW.[6] As a result of Elsevier's decision it was then decided that the IIW Secretariat would take full responsibility

for publishing the journal from 1 January 1999 with expectations raised that this would result in some savings.

Difficulties, it must be said, did occur over the first year of the Secretariat taking on board the publication of the journal, with delays in distribution that were attributed to deficiencies in the material handed over by Elsevier, including circulation lists, which required a great deal of effort to put in good order and costs were higher than expected. The WG *Publications*, chaired by Dr Giulio Costa (Italy) was to take control of this situation by developing strategies for promoting and increasing sales of the journal that currently had only 200 subscribers and a circulation of 300 copies.[7] Previously the number of papers published in WiW, on a yearly basis was around 20 papers, which increased to around 35 papers after the journal was changed from its bilingual form to English in 1994.[8] A total of 250-300 technical documents were initially reviewed for publication of which about 30-40 were judged to be most valuable by the Working Units and recommended for inclusion in WiW. According to size (length) they were either published as journal articles or as a book, or booklet.[9]

Even so, concerns still continued to be expressed about the deteriorating status of the WiW journal. As a result WG *Publications* was then placed under the direction and guidance of the TMB in July 2003 with the intent of improving WiW's image and circulation through proper marketing and planning, as well as arresting declining subscriptions. Subscriptions had become worrying in 2003 when income was reported to have fallen by 16% with a significant decline in profits.[10]

*Veronique Souville*

The year 2005 also heralded a name change for the WG *Publications* to WG *Communications* (WG-COM), later changed to WG *Communications and Marketing* (WG-COM&MARK), along with the appointment of a new Chair, Dr-Ing. Cécile Mayer (France), whose remit was to provide a new dynamic for the publication of IIW's flagship, as well as a firm commitment to increase its status to a premier scientific publication. One of the immediate changes implemented by the Working Group was to increase the size of the journal to around 12 articles per issue. This had a corresponding effect on the number of articles published yearly and a workload that the publication coordinator within the Secretariat, Ms Véronique Souville, handled with charm and distinction.

In a further measure of its new path to excellence Mayer was to announce, rather proudly, that WiW had been published within its deadlines for the second consecutive year in 2007. This still did not disguise the fact that by 2009 WiW was what could be termed

'in dire straits' in terms of circulation and revenue.[11] A financial evaluation of all operational aspects of IIW's publications by the IIW Secretariat, including WiW, selling of books, copies of documents and income from royalties and copyright, revealed that IIW was making substantial losses in 2009 from its publication activities.[12] The major reason for the losses were the labour costs involved as well as those for self-publishing of the journal.

*Bruno de Meester*

There clearly was some urgency in addressing these losses, and to improve the overall efficiency of the production of the journal. Self-publishing was not the answer that it was once thought to be after the agreement ended with Elsevier in 1998. Improving the status of the journal as a result became a definitive strategy of IIW's WG-COM&MARK.

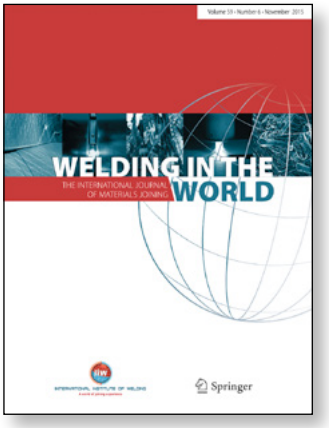
The first step in doing so was the election of editors external to the IIW Secretariat. This occurred with the appointments of Prof. Bruno de Meester (Belgium), Prof. Dr-Ing. Thomas Böllinghaus (Germany) and Prof. Dr John Lippold (USA) as editors. In addition, the relevant TMB members and Working Unit Chairs were included on the Editorial Board and Peer Review Panel.[13]

*Thomas Böllinghaus*

The first task of the Editorial Board was to streamline the peer review system which had been introduced a year earlier to improve the quality of papers produced through the Working Units. This was a necessary step since IIW had long cherished the inclusion of its journal in the Thomson Reuters Science Citation Index™ (SCI), which provided a measure of the quality and impact of scientific journals. This significant milestone was achieved in 2010 and was backdated to the time of application in 2009. It was said of de Meester and his fellow editors that their combined efforts had contributed significantly to the acceptance by Thomson Reuters of WiW in SCI.[14] In acknowledging this achievement, the President of IIW at the time, Prof. Dr-Ing. Ulrich Dilthey (Germany), recognised that 'This could not have been achieved without the indefatigable efforts, steadfast commitment, unequivocal dedication and unwavering faith of the IIW Secretariat, the Editors, the Editorial Board, as well as a superlative review system.'[15]

*John Lippold*

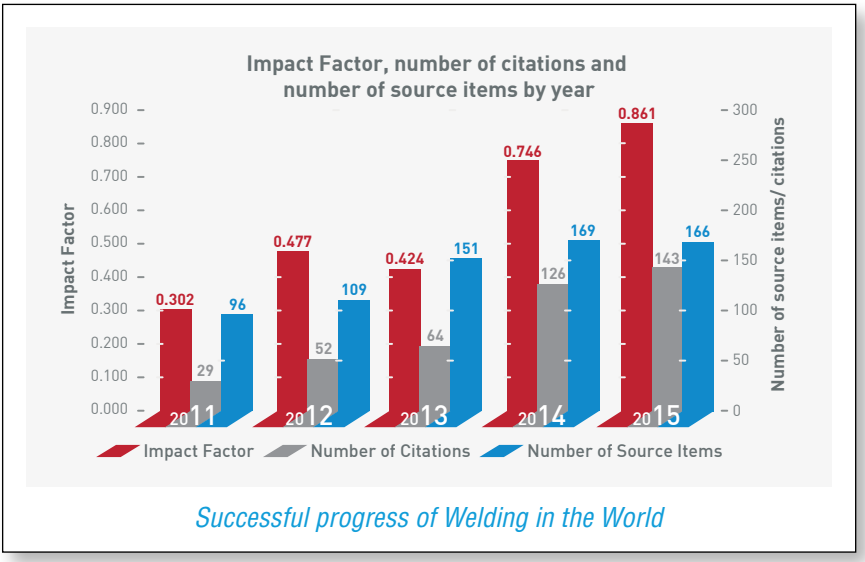
Lippold was also to underline the importance of the management of the peer review system through the Editorial Board, as Principal Reviewers. On occasion the review system could comprise up to 50 people at a time who, according to their area of expertise, were capable of assessing papers in order to meet the quality requirements and the time frame needed for publication.[16] In total there were 194 reviewers for WiW and it remained essential to extend the number of reviewers beyond this to cover the increasing quality and number of papers being submitted for publication.




The costs of in-house publishing of WiW still continued to be problematic with expenses exceeding budget due to the necessary overlap of IIW Secretariat staff to accommodate the retirement of Souville in 2012, after nearly a decade of excellent service overseeing the production of the journal. The desired move out of self-publishing finally eventuated when the Chair of the TMB, Prof. Gary B. Marquis (Finland), announced that year that 'a new partnership with world-renowned publisher, Springer-Verlag augurs well for the future of the journal which will hence become available to tens of thousands of new engineers, researchers and industrial partners'.[17] Lippold was to endorse Marquis' remarks by saying that this move assisted greatly in the acceptance of the journal and its status as a front-line technical journal.

The Editorial Board was to make numerous changes to streamline systems including the implementation of a modern electronic editorial system to greatly reduce the review timeframe. The online editorial system enabled approval for papers to be published quickly, allowing papers to be made available online up to four months before they appeared in hard copy print.[18] As a result IIW moved into the electronic age with both the e-version and printed version of its celebrated journal being made available. The early publication of articles was taken to a higher level later with the introduction of 'online first' whereby subscribers could download papers before publication and pay for them individually.[19]

In addition a new homogeneous design was introduced for IIW books and booklets to mirror the changes to the design layout of the journal. IIW was also to venture into the world of e-publishing and a partnership was set up with a single printing/marketing house, Woodhead Publishing, to facilitate this process. The first IIW books to benefit from this were published in autumn 2012.[20] These were authoritative works on fatigue – *IIW Recommendations for the Fatigue Assessment of Structures by Notch Stress Analysis* and *IIW Recommendations for Methods for Improving Fatigue Strength of Welded Joints*.




*Successful progress of Welding in the World*

For its debut through Springer in 2013, the journal was retitled *Welding in the World: The International Journal of Materials Joining*. This was the same year in which 50 years of publication of WiW was celebrated by IIW. During the period 2013/14 the journal made a profit of just over EUR 20 000 for each of those years, which was considered to be acceptable and there were expectations that this should improve as exposure of the journal became more widespread in the scientific community.

In terms of its impact, as measured through the SCI, WiW had clearly made great strides towards becoming one of the world's leading scientific journals for welding, joining and related technologies. As a measure of its success, when the journal was first assessed via the SCI in 2011, the impact factor (IF) was 0.302. By the end of 2015 the IF had risen to 0.861. This was a remarkable achievement in such a short space of time, since most journals take several years to establish a meaningful IF of that level.[21] The chart above demonstrates quite clearly the increasing trend of growth in the quality of WiW in the period from 2011 up to 2015. In terms of its popularity, almost 45 000 downloads of papers took place in 2015 compared with approximately 38 000 in 2014.

*Ian Richardson*

Prof. Dr-Ing. Ian M. Richardson (The Netherlands) then replaced the retiring de Meester on the Editorial Board and

Lippold took on the role of Chair of the Editorial Board. Also, at that time, open submission to WiW was introduced to allow manuscripts to be submitted directly to the journal without prior screening and recommendation by the IIW Working Units. This process allowed papers to be screened by the editors first and then reviewed by the appropriate Working Unit Chair before going through the peer review system, if considered acceptable. This change allowed greater improvement in quality and diversity in the submission of papers. Over 170 papers were submitted by open submission in 2015, with 30 of this total entering the peer review system. All three editors were justifiably proud that WiW was to publish 90 papers in the six issues in 2015, all of the highest quality resulting in the publication of over 900 pages of fundamental and applied research associated with materials joining.[22]

In addition to the continuing role of WiW as the flagship for IIW, an important part of the 2013-2017 business planning process was the opportunity to implement modern communication technology for global technology transfer.[23] It is difficult to believe that, looking back to 1990, the main asset of IIW in terms of communication was an elementary global telephone system that made it easier to contact people all around the world and little else.[24] At that time IIW also had a rather antiquated computerised database listing technical documents that had been prepared by its respective Working Units. The aim of the database was to make the documents, which were stored on floppy discs, available to industry at a cost of CHF 2 250 for the full set.

The database covered topics such as welding processes and allied technology, physics of welding, design and fabrication, fatigue of welded structures, welding terminology, etc. This was really the first attempt by the Institute to enter a 'brave new world' in the use of computerised systems for both information storage and the dissemination of technical documentation. Further progress was minimal despite continual advances in computer technology although IIW was to further update the database and software when Windows and DOS versions became available in 1995.

Cécile Mayer

In embracing technical change the Institute introduced an electronic bulletin board in 1994 that was not successful and was little used since it failed to stimulate interest among members. Interest in the database also started to decline around the mid-1990s, in all probability due to the increasing costs of updating information to current subscribers of the database.

However, two important initiatives that did attract keen interest were the publishing of the 1st edition of *Fatigue Design of Welded Attachments and Joints* by Prof. Dr-Ing.

Adolf Hobbacher (Germany), and the 4th Edition of *Reference Radiographs for Assessment of Weld Defects* by Deutscher Verband für Schweiβen (DVS), the German welding society, which were issued in 1996.[25] Both these publications were well received. In the case of the reference radiographs these had been produced using the latest digital copying techniques and were to become one of the more important sources of revenue from publications for IIW.[26]

Diminishing interest in the database, noted earlier, together with a need to market the Institute's image more effectively, was to stimulate a corresponding level of interest in the development of a website for IIW, specifically to attract a much wider audience. Reacting to the use of new technology in digital communication, the CEO of IIW's Secretariat, Mr Michel Bramat, made a presentation in 1998 to the WG *Publications* to promote a project for the creation of a website at a cost of FRF 130 000. Expressions of interest were sought from a number of parties to provide resources to undertake this project. Following a review of the respondents regarding the project, the WG *Publications* recommended to the Board of Directors an offer of FRF 90 500, including one third of the cost going towards the integration of the database into the website.

Within nine months of final approval the Internet site became functional in April 1999. However, it did receive mixed reviews during its first year of operation due to the normal problems associated with an initiative such as this. Further improvements were made to respond to criticism and a new version was launched in 2001 with an updated user-friendly navigation tool and facilities for access to both public and restricted areas of the website. The next stage was to improve the content of the website and by 2003 all Working Units were using it for the storage and distribution of their documents. With these improvements, the usage of the website went up considerably. Within two years, visits per week went from around 500 to 1 150. This was viewed as an indication of increased popularity and satisfaction in the changes made.

With a marked increase in downloadable documents and with over 12 000 records in place the website was becoming a victim of its success, moderate though that was, and the increase in website traffic was starting to cause the website to crash or slow down as a result. Not surprisingly this was often due to difficulties caused by multiple entries of the same document into the database.[27] It was evident that a major upgrade would be required to keep it functioning satisfactorily. By 2007 the need for change became acute and the Chair of WG-COM&MARK, Mayer was to comment on the difficulties that faced the Secretariat and that modification of the website was somewhat more problematic than thought. As a result, in-depth discussions began with the aid of feed-back from the users of the website to improve the situation.[28]

A steering committee was eventually set up to look into the development of a new, interactive website that would better respond to the needs of IIW's members and its

stakeholders. The year 2008, therefore, was a transformative one for the website and database through the efforts of the steering committee. The mammoth project for the website was completed within its time frame and it progressively became more and more operational in the latter half of 2009. In anticipation of its success, Dilthey said 'The new website will thereby facilitate improved communication within the ranks of the IIW and help to improve the image of welding and to promote the aims and objectives of our organisation'.[29] Mayer, in extending her sincere gratitude to key persons, made special mention of Ms Sheila Thomas (UK) for her assistance and sterling efforts in making the website the success that it was. Mayer was also to reflect on the past means of distributing information within IIW and drew comparisons to a time when she first became associated with IIW in 2001 as the French delegate to Commissions IV *Power Beam Processes* (C-IV) and VI *Terminology* (C-VI). 'When I started it was not surprising to see a Chairman with a second suitcase containing hard copies to be shared with the delegates. Now we have a robust electronic management system and we are using modern communication tools (online meetings, Facebook, news on website).'[30]

*Sheila Thomas*

*Sylke Kanits*

Lingering disappointment with the earlier versions dissipated with the introduction of the new website and database. It was a key marketing and communication tool which led to a significant increase in visitors accessing the site. According to the new Chair of WG-COM&MARK, Mag. Sylke Kanits (Austria), the website had a staggering 60% increase in traffic in its first year of operation.[31] Kanits, who came from a marketing background, took over the Chair of the Working Group from Mayer in 2009 and in doing so was to bring about significant changes in the promotion of IIW and the way it was presented to the world as a scientific organisation.

The database, which was incorporated into the website, was another aspect that required continual updating and improvement and considerable effort was expended in doing so. For example, in 2013, around 7 000 papers from the period 1980-2000 were retrieved from microfilm and transferred to the IIW database. By 2015 it was reported that a further 15 000 papers had been transferred to the database and that the number of downloads had increased by 26%.[32]

Little was done to promote IIW prior to 1990 although a promotional brochure *What Does IIW-IIS Mean?* was prepared after the 1988 Annual Assembly. Apart from flyers produced for the promotion of Annual Assemblies it was not until Bramat, in 1997, that the first explanatory and promotional text was produced explaining the functions and activities of IIW and the services provided to its membership. The new CEO of IIW's Secretariat, Mr Daniel Beaufils, then was to immediately see the benefits of promoting IIW with the production of his first Annual Report that had great appeal to the membership when it was first issued in 2003. The quality of the Annual Report was to increase significantly from this point as a consequence of his efforts and those of WG-COM&MARK. A high quality brochure called *IIW a World of Joining Experience* was published in 2006 to set a new benchmark regarding IIW publications. In conjunction with this, and the fast approaching 60th Annual Assembly in Dubrovnik, a special medallion incorporating a new logo was designed and presented to those attending this auspicious occasion.

*Special medallion, incorporating the new IIW logo, presented to delegates at the 60th Annual Assembly in Croatia*

The ongoing efforts to bring about improvements to WiW did not lessen the need to become more professional in outlook in other areas and in fact provided greater impetus to the development of a range of IIW brochures. One such initiative was to market IIW's Qualification and Certification programmes through various media, such as the Internet and printed brochures, highlighting the benefits of the scheme and of becoming a member of IIW. Equal success was achieved through special slide presentations at IIW and IIW-supported events such as international conferences, colloquia and congresses. Work of this nature was to result in a generic paper covering IIW's activities that was to become a feature on the home page of IIW's website.

Work continued apace on other external marketing and communication projects, in particular the concept of an IIW Corporate Brochure that garnered considerable prominence during 2010/2011 since it served a valuable purpose in the presentation and promotion of IIW, its products and services, and greatly enhanced the image of IIW and welding. This Corporate Brochure was unveiled at the 2012 Annual Assembly in Denver. Like other brochures, such as *IIW and the Future* and the latest in the new Corporate Brochure series, *IIW Values* and *IIW Technical Working Units*, it was to feature prominently on the home page of IIW's website. The new Corporate Brochure series, incidentally, incorporated the latest technology for reading e-documents on a page-by-page basis. Both the original

Corporate Brochure and the revisions were to achieve great success and were given to Member Societies for distribution among their members and to local organisations and governments involved in decision making in the region.

Extensive use of best practice and guidance documents by IIW also indicated the fundamental shift in how IIW was seeing itself in a rapidly changing world. IIW stated its Mission as 'To act as the worldwide network for knowledge exchange in joining technologies to improve the global quality of life'. By doing so, one of its principal objectives was to identify, create and transfer world's best practices for sustainable development in a sustainable environment, very much an integral part of IIW's latest Business Plan.[33] Marquis, IIW President 2014-17, in expanding on the importance of this, commented that 'Many units pursue ambitious programmes to develop IIW Best Practice Documents and IIW Guidelines. These documents are in great demand to industries who view the IIW logo as a symbol of quality and scientific and engineering excellence. They also serve as a key starting point for new international standards and new research fields.'[34]

In line with the continuing success of these initiatives a novel communications survey was conducted at the Denver Annual Assembly in 2012. The results of the questionnaire were overwhelmingly positive and expressed a need to engage the wider community in attracting young leaders and people to become members of the IIW family. Earlier, identifying the means of attracting young engineers to IIW was raised in the preliminary discussions of IIW's Business Plan at the Florence General Assembly in 2000.[35]

Consideration was given to the application of lower registration rates and better promotion to universities where many prospective young welding engineers originated from. At the time, many members of IIW were known to subsidise young professionals to attend IIW Annual Assemblies, conferences and congresses, either directly or through sponsorships with welding companies.

The initial steps to communicate with young people to encourage them to participate in IIW were put in place in 2009 through the creation of a special registration category for IIW events. This was done with the support of DVS which already played a significant role in the encouragement of young professionals to attend IIW Conferences and Annual Assemblies, particularly for the 62nd IIW Annual Assembly and Conference in Singapore in 2009.[36] As a result of encouragement by IIW and through the organisers of IIW events, the representation of young professionals increased significantly to such an extent that the first Young Professional International Conference (YPIC) was held in Hungary in September 2014. It was presented under the auspices of the Hungarian Welding Society which showed great initiative in staging this conference to communicate and establish a dialogue with young professionals. Supported by IIW as an associated event, it also encompassed an international welding competition for young persons involved in the practical side of

welding. It was an unrivalled success in communicating with young people and an equally successful YPIC was again held in Budapest in the following year (2015), with a third planned for Germany in 2017.

*Madeleine du Toit*

Prof. Madeleine du Toit (Australia), who succeeded Kanits as the Chair of WG-COM&MARK in 2013, saw one of the Working Groups' main objectives as creating a dedicated forum for young professionals within the framework of IIW and the pursuance of innovative ways of communicating with the younger generation. These efforts were to lead to greater involvement of young professionals in IIW's Annual Assemblies and Conferences and it was announced after the Annual Assembly in Helsinki, Finland in 2015 that 'the recent focus on young professionals was rewarded by the participation of over 80 "future leaders" of the global welding community'.[37]

The highlight of the assembly was a Young Professionals Evening where the only real challenge was to have fun and make friends. Imbued by the attendance and success of the meeting Marquis, IIW President at the time, sent out a flotilla of cars to scour the neighbourhood for pizzas and to bring as many back to the meeting as possible. It was a cordial evening which cemented many relationships and the realisation that this could drive IIW to new heights through the next generation of leaders and scientists. Modern techniques of communicating by social media through networking, such as a Young Professional Corner on IIW's website, Facebook and Twitter accounts, naturally became 'de rigueur' for this new generation of welding engineers who were starting to take up much greater interest in IIW than ever before.

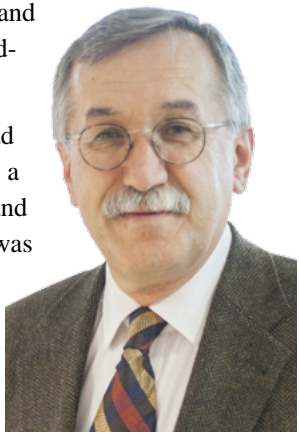
From another perspective, it is easy to underestimate the role of IIW International Conferences and International Congresses as a means of communication between people and the importance of the opportunities they gave for both networking and dissemination of information on the latest advances in technology and research. The backbone, or engine room of the IIW, has always been its Working Units especially the Commissions. These Working Units served as global centres for the communication and exchange of scientific information in their areas of expertise.[38] Strong international networks have been formed uniting experts and professionals from industry, research institutes and the world's leading universities – the very centres of excellence that young professionals aspire to graduate from.

The outputs from these Working Units, in communicating IIW best practices, guidelines, documents and standards, are symbols of quality and scientific excellence that

*Young Professionals enjoying networking at the IIW Annual Assembly, Helsinki 2015*

are also in great demand by the welding industry. The highly effective communication networks that are now part of the Institute's framework enable this to take place and are testament to the planning and endeavours of the many people who are part of the IIW.

From another point of view, the IIW *White Paper* (WhiP) was a speciality communication document published in 2012 through the assistance of a number of Member Societies which provided financial support for the project. It was another means of stimulating interest in the development of a vision for a sustainable future by the members of IIW. It received immediate acclaim from the membership and much of the material contained in the document was provided by 79 IIW experts from around the world.[39] The concept for the paper came from Mr Chris Smallbone (Australia) during his term of office as President 2005-2008 together with co-editor Dr-Ing. Mustafa Koçak (Turkey). The 165-page WhiP described strategic challenges and agendas for welding industries, personnel, scientists and end-users through the next 10 years to 2021.



*Mustafa Koçak*

The WhiP was meant to inspire those across a broad spectrum of the welding community rather than provide a comprehensive coverage of all things associated with welding and its allied processes.[40] More importantly, the aim of the WhiP was to enhance the image of welding to attract new markets and member nations to the IIW network, including industries and government agencies, and to enlighten them further on the importance of welding as a technology.[41] By the end of 2015 approximately 30 000 hits were received on IIW's website for the *White Paper*.

Dr Baldev Raj (India), IIW President 2011-2014, during one of his Presidential addresses outlined what he believed IIW had achieved regarding communication. It was '…transformation of IIW from an historically renowned repository of knowledge into a modern, dynamic network nucleus of information which responds to present day needs'.[42] It is clear, not only from Raj's words, that the ongoing changes in communication technology over the last 25 years were to herald an even greater change in the future, where a new era of communication technology was about to arrive on the doorstep of IIW!

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# leading the world: harmonisation of education, training, qualification and certification

chapter 5

**“Interest in the IAB system is global and it is now becoming a truly international system”**

*Mr James Guild,*
*Chair, IIW International Authorisation Board 2014-2017*

*Posters promoting IIW and EWF qualification and certification and EUROJOIN 7*

WHILST QUALIFICATION AND CERTIFICATION WERE NOT A central part of IIW activities during its first 40 years, it did start to change its attitude following the first IIW International Congress in Hobart, Australia, in 1988, where a key emphasis of the Congress was on education and training. The conclusion drawn from discussions was that a regional committee should be formed and a regional Commission XIV *Welding Instruction* (C-XIV) (and possibly others) set up in South East Asia.[1] These proposals were reported to the Governing Council when it met in Helsinki, Finland in September 1989. The creation of the regional committee was duly ratified at this meeting and C-XIV agreed to set up a regional Commission to provide advice on education and training in the Asia-Pacific Region.

C-XIV, which had been in place since 1950, had already started work on the definition of the minimum knowledge requirements of welding engineers in 1987 under the chairmanship of Prof. Manfred Jacobi (Germany) and the work, which could result in a recommendation or a standard, was considered to be very important in the context of the mutual recognition of diplomas and qualifications.[2]

It is important to point out that at this time there was considerable confusion regarding the actual meaning of the term welding engineer. For instance, it could be a company title having no institutional or other forms of recognition whereas, in some countries, it may be a protected title which can only be used when the person has specific qualifications and experience. This was to also apply to other forms of professional welding categories since, literally, there were many thousands of welding professionals throughout the world who had little or no formal welding qualifications.

Certain countries, such as the USA, Germany and Russia, already provided tertiary courses for welding engineers but, in the main, most welding engineers graduated to this position through an informal process of acquired knowledge and experience. Education in welding technology was reasonably commonplace at a university level, either as part of another engineering degree course, or as a stand-alone subject, on a semester or annual basis. For students who had completed their engineering degree, postgraduate courses and sometimes master's degree courses were offered in welding technology.

The Institut de Soudure, in France, introduced a one-year postgraduate course in welding as far back as 1931 and Ohio State University in the USA was perhaps one of the

first universities to provide a full-time degree programme when welding engineering was established within its Industrial Engineering Department in 1948. The Cranfield Institute of Technology in the UK, another example, was established in 1961 and also offered postgraduate welding courses and these were regularly advertised throughout the 1970s, or even earlier than this. Other universities in the UK offered postgraduate degree courses for welding engineers including the University of Strathclyde and Aston University in Birmingham. The E.O. Paton Electric Welding Institute in Ukraine added a new dimension to the qualification of welding engineers when literally hundreds of welding engineers graduated each year from their training centres throughout Russia and through courses supported by the United Nations Industrial Development Organization (UNIDO).

Until the late 1980s almost every industrialised country had its own system for training, qualification and certification of welding personnel. There was, however, no other uniform means outside national boundaries of assessing whether or not welding professionals, or practitioners, fulfilled the requirements expected of them. There was wide disparity from country to country and with increased trade and mobility of labour, or skills, it became imperative that some form of harmonisation between national programmes be introduced to ensure uniformity and transferability in the education, training, qualification and certification (ETQ&C) of welding personnel.

In Europe there was already a wide interest in harmonising qualifications of welding professionals, such as welding engineers, technologists and specialists, through the European Council for Cooperation in Welding (ECCW) which was founded in 1974. Members included Belgium, Denmark, Germany, France, Ireland, Italy, The Netherlands and the UK – all members of IIW although Ireland withdrew from membership of IIW at a later date. In the 1980s, a series of 'guidelines' were developed by ECCW as part of a European funded project. The aim of the project was to establish a single harmonised system for the ETQ&C of Welding Engineers, Welding Technologists and Welding Specialists throughout Europe.[3]

At the conclusion of the project it was quickly realised that the implementation of the new guidelines needed to be controlled in order to ensure uniformity, without which confidence in the harmonised system would be lost. What was required was a quality assurance approach that involved the auditing of qualification and certification bodies in accordance with agreed criteria. Mr Tim Jessop (UK) of TWI was foremost in introducing this approach through his work with the UK National Accreditation Body on the proposed new European Standard for the accreditation of personnel certification bodies. TWI became the first certification body in Europe to achieve accreditation to the new standard.[4]

It was this approach that was adopted by ECCW when it changed its name to the European Federation for Welding, Joining and Cutting (EWF) in 1992. The intent of EWF was to extend a partnership arrangement for the recognition of welding qualifications to

all countries in the European Union as well as to some eastern European countries. Jessop was to play a key role in helping EWF develop its own criteria, based on the European Standard, for personnel certification bodies. With the guidelines for European Welding Engineer, Technologist and Specialist already prepared, EWF then commenced its entry into delivering qualification for these categories with the approval of Portugal as its first EWF Authorised National Body (ANB). This was followed in quick succession by Italy and the UK which already had the requisite systems in place to undertake qualification. Jessop was to take on the role of the first Lead Assessor and by 1995 had audited all of the EWF ANBs that had been accredited by that date.[5] EWF had the good sense to copyright all its scheme procedures and documentation in 1994 to prevent unauthorised use. This documentation was judged to be of the highest quality and had taken considerable time and effort in its development.

Outside of C-XIV there was little action by IIW on harmonisation of qualifications. Greater awareness of such matters was further highlighted through an International Colloquium on Welding Education and Training that was organised by the Commission in Montreal, Canada in 1990 during the Annual Assembly. A working document for the *Approval of Personnel Engaged in the Inspection of Welded Joints* was also issued in 1991 through a C-XIV Working Group (WG5) under the chairmanship of Mr Len Gourd (UK) but similarly failed to gain much attention at an executive level.[6] There was no mention of it at all in the important strategic plan that was put to the Executive Committee in 1992 to guide IIW towards the year 2000.[7]

However, at the IIW Annual Assembly in Madrid, Spain in 1992, some progress did eventuate when C-XIV decided to commence work on a harmonised global system for ETQ&C, taking into account the needs of all nations around the world, not just in Europe. This resulted in the formation of a new Working Group (WG 13) of C-XIV chaired by Mr Chris Smallbone (South Africa). This group would hold six meetings over the next two years in order to progress further the detail of the requirements of implementing such a scheme. C-XIV, more cognisant of the implications of the EWF qualification programme, then put forward a project concerning the guidelines and rules for the ETQ&C of welding personnel. In keeping with this new approach, C-XIV was to change its title from *Welding Instruction* to *Education and Training*.

At the Beijing Annual Assembly in September 1994, two all-day meetings were held by WG 13 outlining the progress made by the Working Group. The meeting, on the first day, was attended by 46 IIW participants from around the world. This meeting covered key issues such as the implementation process and the need to address certain other concerns without holding back the scheme.[8] At the conclusion of the meeting, on the second day, two resolutions were proposed to proceed with the IIW international qualification and certification scheme. These resolutions were 'that the IIW voluntary scheme for the education, training, qualification and certification of welding personnel, as outlined in document XIV-574-93 now be implemented' and the other resolution was 'that the Governing Council shall establish a new Committee "Qualification + Authorisation", which will report directly to the Governing Council'. The two resolutions were adopted by all those present. On the following Saturday the Governing Council of IIW unanimously approved these resolutions to go ahead with a global scheme for the ETQ&C of welding personnel.[9]

*Christian Ahrens*

*Wolf-Dieter Strippelmann*

C-XIV, through its WG 13, was then entrusted by the General Assembly in Stockholm, Sweden in 1995 to prepare a draft guide to cover all aspects involved in the qualification and certification of welding personnel. Dr Ralph Long (USA) and Prof. Dr-Ing. Wolf-Dieter Strippelmann (Germany) participated actively in this work. A new Commission was also formed (C-VII *Authorisation and Qualification*) to add a further dimension to this initiative through the chairmanship of Mr Christian Ahrens (Germany) with the support of Mr David Reynolds (Canada) as Vice-Chair.[10]

Ahrens was a sound choice for Chair of C-VII having been head of education and training at Schweißtechnische Lehr und Versuchsanstalt (SLV) Duisburg (German Welding Institute Duisburg) for many years. Through his work on C-VII, and a determined approach, he was destined to take on the post of the Chair of the IIW International Authorisation Board's Group A: *Education, Training and Qualification* when it was eventually formed in 1999. Included in the main tasks of C-VII, therefore, were to determine the general admission and transitional requirements for IIW ANBs. In this respect IIW had already acknowledged that EWF had started before IIW in developing its own scheme and it was for this reason that the EWF document *Rules for the Implementation of EWF Guidelines for Training and Qualification of Welding Personnel* was adopted and the EWF ANBs were automatically recognised by IIW in line with that previously agreed between the two parties.[11]

*Tim Jessop*

Other tasks that C-VII was to become closely involved with were the audit processes for IIW Member Countries and the relevant procedures and rules to do this. Jessop was appointed as the Lead Assessor for the IIW International Authorisation Board (IAB), continuing a similar role he had as EWF's Lead Assessor and hence providing the necessary degree of conformity between the two organisations. In particular, he developed a model quality assurance manual aimed at helping applicant ANBs to install their systems in the correct way. The task of WG 13 of C-XIV was now essentially complete and it was disbanded in 1998 with the following commendation, '…Commission XIV resolves to disband WG 13: *IIW Scheme for the education, training, qualification and certification of welding personnel*, which has now completed its work'. C-XIV was also to record its thanks and appreciation for the tremendous effort and results obtained by the members of the Working Group.[12]

In parallel with these developments, discussions had been held with EWF regarding a joint ETQ&C scheme. There was good sense in doing so since C-VII, in performing the preliminary work to establish the IIW IAB, was progressively adopting EWF qualifications which were recognised by ISO standards. As an organisation EWF was also well placed to deliver company certification to complement its own qualification and certification scheme. In regard to this, EWF, already a market leader in personnel qualification, had also become an undisputed leader in company certification. Both Italy and the UK became the first countries in the world in 1998 to have an Authorised National Body for Company Certification (ANBCC) through EWF. Given Europe's immense industrial base there was excellent potential for the expansion of company certification throughout the European Union.

Several of the prominent members of EWF were also members of IIW which was advantageous in achieving common ground between IIW and EWF on the harmonisation of ETQ&C for welding personnel. Ahrens, for instance, had a supportive role in EWF in much the same way as he did for IIW, as did Jessop as Lead Assessor. As a consequence there were lengthy discussions on cooperation on issues that would be of mutual advantage to both organisations should a possible merger go ahead. The ownership and use of the documentation already developed by EWF, therefore, became a prime consideration as well as the payment of royalties for its use.

It was not surprising that an element of misapprehension had developed between the parties during early negotiations and this became more apparent when discussions on payment of royalties faltered.[13] IIW, through IIW Secretariat CEO Mr Michel Bramat, had previously informed EWF that IIW was not in agreement to paying royalties and EWF replied that they had taken note of this decision and that it was disappointing. The impasse

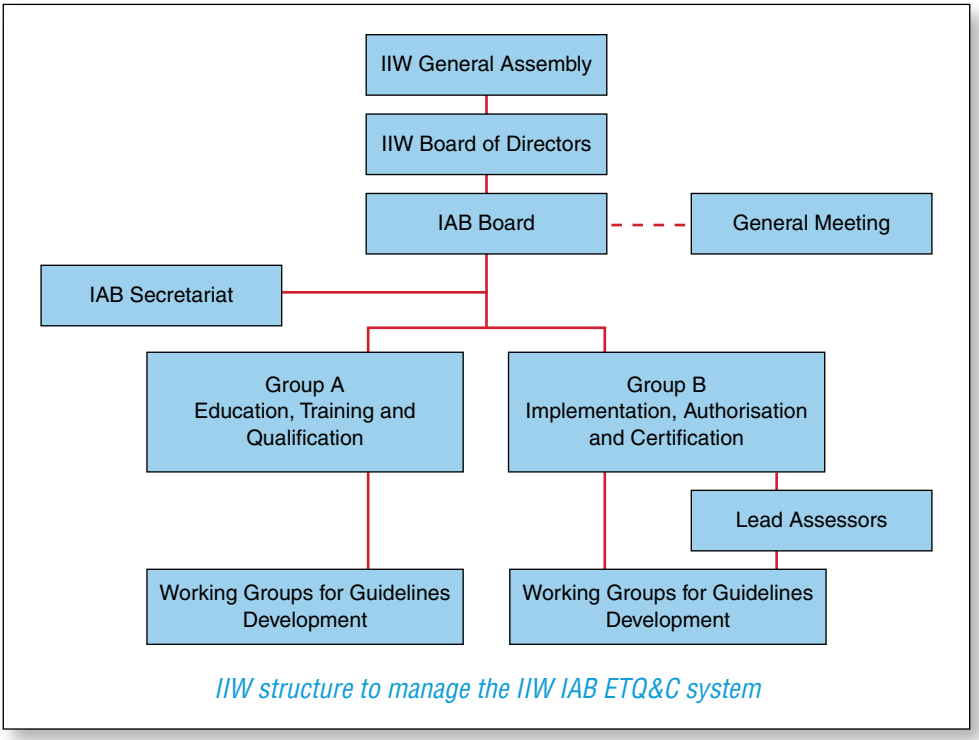
between the two organisations was founded primarily on the fact that IIW would financially benefit from the use of EWF documentation and that this would be unreasonable from EWF's point of view. A compromise, therefore, was reached that IIW's role in the scheme would be established in a similar way to that of EWF, whereby IIW ANBs would pay a fixed fee plus a variable fee based on the sale of diplomas.

To ensure no dispute could arise, IIW then drafted a resolution saying that it did not intend to receive income in excess of its costs for the operation of its scheme. Therefore, any fees paid to IIW by IIW ANBs should only amount to IIW's administration costs.[14] This resolution was subsequently passed by the Governing Council. Prof. Dr-Ing. Detlef von Hofe (Germany), who often acted as a 'peacemaker' in discussions between IIW and EWF, responded by saying that since IIW was not making any profit from the scheme, recognition by IIW of the EWF ANBs, without audit, would be considered fair compensation.[15] For some time the IIW ANBs outside of Europe paid a fixed fee of 5 000 euro (EUR) whereas European EWF and IIW ANBs paid a fixed fee of EUR 3 000

*Detlef von Hofe*

Further discussion did continue with IIW and the CEO of EWF, Prof. Dr-Ing. Luisa Quintino, and the President of EWF Mr Van den Brug. A formal agreement, in principle, was then signed at the Annual Assembly in San Francisco, USA in 1997 to develop an international scheme based on the EWF system. This formal agreement which eventuated between EWF and IIW was aimed at allowing cooperation for the delivery of this scheme, both in Europe and worldwide, leading to a single unified system. In doing so, EWF would also have the right to deliver IIW diplomas to IIW members and to new members in its current sphere of activity in Europe since some countries, not yet members of IIW, had already accredited their ANBs through EWF. There was to be no payment of royalties and IIW would eventually be privy to confidential documentation through a licence agreement which commenced in 1999. Preliminary work to establish IIW's IAB then continued with an agreement for Instituto de Soldadura e Qualidade (ISQ) in Portugal to act as the IIW IAB Secretariat, which was convenient for both partners because ISQ was already acting as the Secretariat for the EWF scheme. Mrs Rute Ferraz was appointed as Chief Executive Officer for the IAB Secretariat and continues to successfully undertake that role.

*Luisa Quintino*




*IIW structure to manage the IIW IAB ETQ&C system*

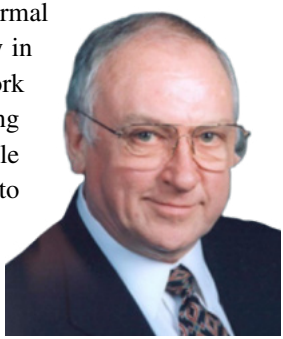
As Chair of C-VII, Ahrens reported to the General Assembly meeting at Hamburg on 18 September 1998 that a very successful meeting was held by C-VII with 59 participants out of 25 countries being present. From a positive point of view 19 countries had already been authorised in advance to act as IIW ANBs, all European, with a further five applicant countries, including Japan, USA and Australia, having expressed interest in becoming the first IIW ANBs outside of Europe.

In order to facilitate this process, two Lead and six Peer Assessors were approved by IIW.[16] Both the IIW and EWF General Assemblies then approved the creation of a Planning and Implementation Group to develop the IIW structure to manage the IIW scheme. This resulted in the creation of an IIW IAB within IIW to manage the ETQ&C system.[17]

There was a cost involved in all of this and the means of covering this had still not been determined when the scheme officially commenced in 2000. Eventually it was resolved, as in previous situations, that income derived from the scheme would come from the payment of fees by the IIW ANBs and income from the sale of diplomas. The proposed budget for 2001 was aimed at being revenue neutral with income and cost set at EUR

50 000 respectively, a position that was satisfactory to EWF, which was a not-for-profit organisation.[18] Income for 2001 actually did turn out to be higher than projected resulting in a modest loss of a little under EUR 7 000, an acceptable result considering that the cost of cross-subsidisation in the first year of operation could have been much higher. The scheme did produce a similar loss in the following year before returning the smallest of profits in 2003.

Having done its main work for the past four years, a formal resolution to disband C-VII was taken at the General Assembly in Florence, Italy in 2000. C-XIV would still continue with its work for the overall membership of IIW, including complementing the activities of the IIW IAB. In readiness for this, considerable groundwork had been done over the previous 12 months by IIW to establish the IAB for IIW. Prof. David Howden (USA), the first Chair of the IIW IAB, was to comment on the generalities of the achievements gained in setting up the IIW IAB and that the next phase of the agreement was to move into a closer relationship with EWF.

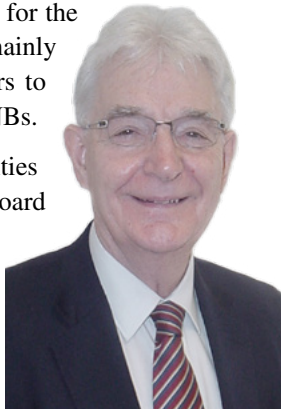


*David Howden*

As part of this process, Van de Brug was contracted as a mediator to find solutions for the organisation of the IIW IAB and its financial arrangement with EWF. Mr Bevan Braithwaite (UK), as the current IIW President, was to add vocal encouragement to this by saying '…a group of people of great knowledge of this area had been set up to work over the last 12 months in order to secure the cooperation of many countries. The big achievement now was to have a scheme for this qualification activity and it is a great credit to all the people involved in this process'.[19] Braithwaite's words were a reaffirmation of the excellent progress that had been made since Lisbon and the growing collaboration and cooperation between members of EWF and IIW in the Planning and Implementation Group that had been tasked with the formidable challenge of getting the scheme up and running.

The first country outside of Europe to have its IIW ANB approved was China in 2000, followed in turn by Japan, Australia and the USA. By the end of 2004, over 24 000 IIW diplomas had been issued and the IIW IAB network consisted of 34 active IIW ANBs. The IIW IAB Group A had expanded the number of categories from the original International Welding Engineer (IWE), International Welding Technologist (IWT), International Welding Specialist (IWS) and International Welding Practitioner (IWP) to include International Welding Inspection Personnel (IWIP) and International Welder (IW), through the establishment of curriculum guidelines for all these categories. The IIW IAB Group B *Implementation, Authorisation and Certification*, chaired by Mr Jeff Huffsey (USA), was

at the same time very active in refining the rules and guidelines for the development and implementation of the authorisation systems, mainly quality control, and the harmonisation and training of assessors to undertake audits of prospective applicants for approval as IIW ANBs.



Chris Smallbone

The question of including certification in the future activities of IIW was first raised in 2002 during a presentation to the IIW Board of Directors on the possible opportunities for the certification of personnel as well as company certification. After considerable discussion it was decided to set up a five-member Task Force *Certification* (TF-CERT) headed by Smallbone, now from Australia, to investigate the future role of IIW in the different fields of certification and report back to the IIW Board of Directors on their findings.[20] A detailed written proposal recommending that IIW should take up certification was submitted in 2003. After further consideration by the Board it was agreed in principle, two years later at the IIW Annual Assembly in Prague, Czech Republic in 2005, that IIW would enter the field of certification. The EWF systems for company and personnel certification were transferred to IIW for implementation in 2007. This included company certification and welding coordination personnel certification but did not include welding inspector certification since it was agreed that would be dealt with at a later date.

Further discussions did take place at a Board of Directors level in January 2008 when the IIW IAB Chair at that time, Mr Bertil Pekkari (Sweden), reported that the IIW IAB had requested that the introduction of a welding inspector certification scheme be discussed again. This was in response to requests from qualified and certified welding inspectors, plus IIW IAB members, for an IIW certification system to cover welding inspection. The matter even then was considered sensitive due to the potential negative impact on the pre-existing welding certification business of some IIW Member Societies.

Germán Hernandez

The IIW Board of Directors agreed to such a proposal and a Task Force was established with von Hofe as Chair.[21] The Task Force, which included the IIW IAB Chair, Mr Germán Hernandez (Spain), later reported that it had failed to agree on the development of an IIW scheme and an alternative compromise proposal had been put forward. This proposal prohibited the use of the IIW logo and the word 'international' on certificates issued in the name of the IIW ANB.[22]

*Another successful IIW IAB meeting, held at the IIW Annual Assembly, Chennai, India, in 2011*

Not surprisingly, the guideline developed in the compromise proposal was not used by IIW ANBs because of the associated restrictions imposed on them through the prohibition on the use of terms such as 'international' and the use of IIW's logo on certificates. The matter was raised again in the IIW IAB by several members in 2012 and the IAB agreed to present a proposal to the IIW Board of Directors to revisit the decision made in 2009. This proposal was made in consideration that other Member Societies were now offering their own inspector certification programmes without geographical restriction in other IIW Member Countries.[23] In light of this the IIW Board concluded that an Advisory Group was needed and this was then set up in January 2013 with Dr Luca Costa (Italy) as convenor.

Numerous examples of Member Countries joining IIW primarily to participate in the IIW IAB scheme became increasingly apparent following its introduction in 2000. This, in turn, had a positive effect in discouraging the development of potentially diverse national or regional schemes.[24] In consideration of this there was a view by several of these members that an IIW Authorised Training Body (ATB) wishing to run welding education or training courses in a foreign country should be expected to first reach an agreement with the local ANB, if one existed.[25]

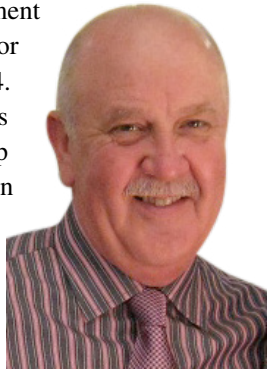
Most affected were more recent members of IIW which were in the process of starting up or establishing an IIW ANB in their own country. This resulted in submissions to the IIW Board of Directors from a number of members who were concerned at the running of alternative ETQ&C programmes in their countries by another member of IIW. In comparison, other IIW members were of the opinion that competition legislation introduced after the IIW IAB scheme had started should allow the expansion of ETQ&C of welding personnel into countries where open markets permit.

Later, the awareness of the possibility of legal action being taken against both IIW and EWF regarding contravention of competition legislation became of increasing concern. The IIW Board of Directors and the IIW IAB then went through an exhaustive legal process to look at options to those that were in existence at that time. These options required either changing the IIW IAB relationship structure or, alternatively, revising the rules and operating procedures to improve compliance with international competition legislation.[26] In recognition of the legal complexities involved, the IIW Board of Directors then issued a mandate to a special IIW IAB Working Group B1+, in 2015, to review the IIW IAB's rules and operating procedures regarding competition legislation.

The Working Group was to use its broad-ranging expertise to identify the rules and procedures that may be affected by the need for compliance with current legislation. Outstanding work was done by this Working Group in defining and understanding the detail of international compliance.

As a result, IIW sought cooperation from EWF to ensure that both organisations were aligned with one another in deciding the best course of action to take.[27] In parallel with this, the IIW Board of Directors expended a considerable amount of effort and time to investigate a broad range of alternative structural systems without success. Ultimately, it was agreed to continue to meet the requirements of competition legislation through the proposed amendments to the rules, guidelines and other appropriate IIW documentation.

In viewing, to some extent, the earlier years of IIW's involvement in ETQ&C, Ahrens, as Chair of IIW IAB Group A was rewarded for his efforts by being reappointed for a further term of office in 2004. On this occasion he was to say, 'The job of Chairman of IIW's IAB Group A is, from the personal view, easy because all group members have the same aim to improve the international education and training system in welding'.[28] Ahrens was to continue in the role of Chair of IIW's IAB Group A for a further six years until he retired in 2011. Mr James Guild (South Africa) was also a long-serving Chair of IIW's IAB Group B and, after retiring from this position a few years later, played an equally effective role later as the Chair of the IIW IAB 2014-2017.



*Jim Guild*

The year 2005, incidentally, was a turning point in the development of the IIW ANB scheme which, by that time, comprised 32 countries that had attained IIW ANB status, consisting of 25 European and seven non-European countries, plus three applicant countries. This was creating significant work for the IIW IAB Secretariat and, in order to reduce inefficiencies and streamline activities, it was decided to combine both EWF and the IIW IAB into a joint Secretariat, effective from the 1 January 2006. It also corresponded with the Institute's move into IIW company certification through the launch of the IIW Manufacturer Certification Scheme (MCS) According to ISO 3834 *Quality Requirements for Fusion Welding of Metallic Materials*.[29]

The IIW personnel certification scheme was introduced in January 2008 and in recognition of the efforts by EWF in the prior development of personnel certification procedures, the IIW IAB agreed to promote both systems for the coming three years as compensation. As an indication of the growing closeness between IIW and EWF the first publication of a joint Annual Report earlier in 2006 showcased the attributes of both organisations in the operation and dissemination of information for qualification and certification activities.

The following years involved rapid expansion, both technically and geographically. The IIW IAB continued its activities in the development of systems in regard to qualification and certification in countries outside of Europe. It launched three new Working Groups that undertook the development of new guidelines for ETQ&C in the areas of Mechanical, Orbital and Robot Welding, Mechanical Destructive Testing, and Welding Safety. At the same time IIW undertook a management review of the IIW IAB through a Board-appointed Task Force under the Chairmanship of Dr-Ing. Stefano Morra (Italy) to develop new strategies and a wider participation of IIW ANBs and ANBCCs in the management process. In furtherance of these objectives the IIW IAB later initiated a Task Group to look at ways of improving the marketing and promotion of the IIW schemes.

*Stefano Morra*

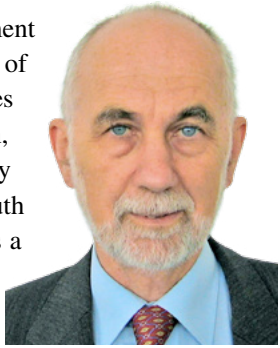
One of the pleasing results to come out of 2008 was an increase in diplomas awarded, which was attributed to the fact that more and more IIW ANBs were entering the system. One surprise was '…that very few, only 1 500 IW diplomas had been awarded, compared with 2.5 million welders in the world'. In this respect there was a huge need for increased attention by all ANBs with regard to the potential to increase welder qualification.[30] Of particular interest, also during that year, was the implementation of a new harmonised examination database that provided a much higher level of consistency in the preparation of suitable questions for examinations.

EWF's access to European funding was to enhance the examination database through the development of more than 600 questions that were eventually added to the database in five different languages. These were then evaluated through pilot tests conducted with ANBs throughout the IIW IAB network. The initial aim, as Guild commented, was to have 25% of all questions in an examination paper populated from the database. The key driver behind the development of the examination question database was Mr Italo Fernandes (Portugal). In subsequent years the numbers of questions generated from the database were to increase substantially through his efforts and those of the many volunteers from IIW ANBs that had worked tirelessly on the compilation and verification of questions and answers for the database.

*Italo Fernandes*

Germany was by far the biggest supporter of both EWF and IIW IAB diplomas, with China in terms of numbers becoming the most prominent supporter of the IIW IAB scheme outside of Europe. With respect to certification for companies, Italy was also quite prominent although a developing interest by several Balkan countries, such as Bulgaria, Czech Republic, Slovenia, Slovakia and Romania, was to accelerate company certification in this region.

The outstanding work of the WG-RA, with its involvement in regional cooperation and the establishment of networks of Technology Support Centres and Education and Training Centres were guiding factors in this success. Prof. Dr-Ing. Dorin Dehelean, Executive Director of the Romanian Welding Society, was the key figure on the ground who was able to unite the countries of South Eastern Europe in a common cause and saw this involvement as a means to raise the technical and living standards of the people in the region.[31]



*Dorin Dehelean*

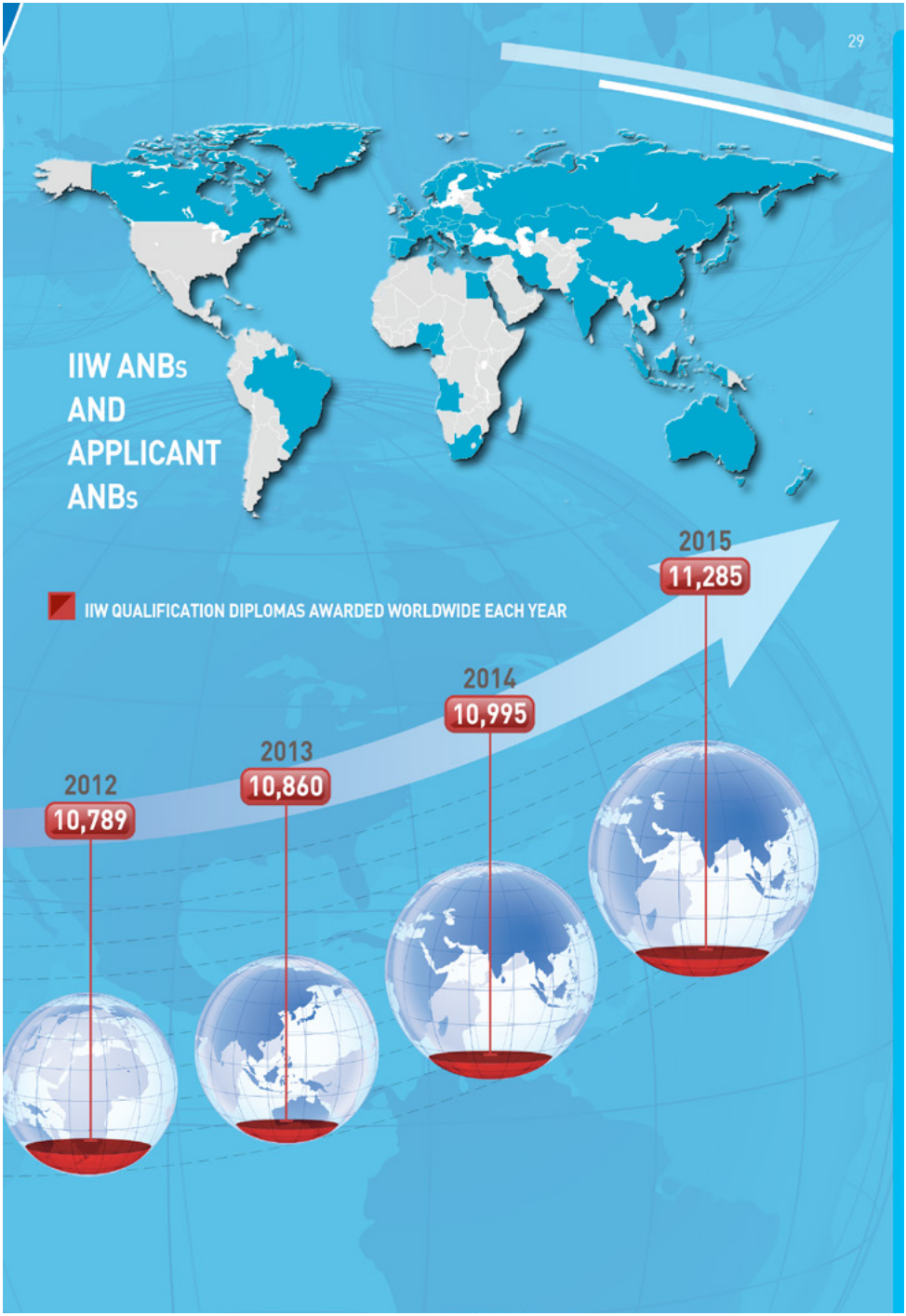
In the first year of operation, the involvement by countries in company certification was totally European in nature, with a total of 14 IIW ANBCCs from Europe and only three applications pending external to Europe. The following years were periods of consolidation through the continuation of activities in updating existing guidelines and the development of new ones to address potential markets such as certification of welders. Europe, it must be said, still accounted for 80% of all diplomas issued although diplomas outside of Europe were now starting to increase due mainly to greater interest in the 'Triple A Region' – Asia, Africa, Australasia (AAA).

With the agreements with ISQ and EWF coming to a close, preliminary discussions regarding the IIW IAB and the respective authority of its officers were undertaken at the first meeting of the Task Group *Governance* (TG-GOV) in 2008. This was appropriate since TG-GOV had been formed to improve the operational clarity of how IIW carried out its affairs and the licence agreement between IIW and EWF was an important process by which both organisations would work closely together. At this meeting it was stated that ISQ had managed the work for both EWF and IIW within the framework of the existing contract between ISQ/IIW and EWF.[32] A new contract, therefore, was required to be negotiated before the end of 2009. A further meeting was held between IIW and EWF representatives at TWI in Cambridge, UK in December 2008. It was agreed that, since EWF owned and maintained the copyright of the operating documents, then the right for IIW to use this documentation was still conditional on a new licencing agreement between the two organisations to replace all previous agreements.

At the meeting of the Board of Directors in January 2009 the licence agreement between IIW and EWF was discussed. It was then recommended by the Board that a new licence agreement be prepared between IIW and EWF and that a Secretariat contract be also prepared between IIW, ISQ and EWF. Certain points of this draft licence agreement were discussed at a later meeting of TG-GOV in Singapore on 14 July 2009 including the end date at which point both EWF and IIW would be free to use the documents.[33] At the Board of Directors meeting two days earlier, the IIW President Prof. Dr-Ing. Ulrich Dilthey (Germany) had proposed that the terms of the draft licence be agreed upon and that any comments be submitted by email since the dateline for signature was the end of the year 2009.[34]

The licence agreement between IIW and EWF was actually signed just before this deadline on the 24 November 2009 by Dilthey for IIW and Jessop for EWF. IIW was granted non-exclusive rights within Europe and exclusive rights elsewhere, to market, use and offer for sale, EWF intellectual property over a 20-year period. This period commenced from the end date of the original agreement which had been signed with EWF on 1 January 1999. At the 2010 Annual Assembly in Istanbul, Turkey, two months later, concern was voiced by certain members of IIW regarding the licence agreement.[35] After these concerns were addressed the Board of Directors then confirmed the licence agreement with EWF. Included in the licence agreement was the payment of royalties to EWF for a fixed period of time. This, interestingly, was an issue much debated prior to the signing of the original licence agreement with EWF when royalties were not included.

The IIW Board of Directors then saw a rejuvenation of C-XIV as a key Working Unit instrumental in the accomplishment of the goal 'to identify, develop and implement


29
IIW ANBs
AND
APPLICANT
ANBs
IIW QUALIFICATION DIPLOMAS AWARDED WORLDWIDE EACH YEAR
2012
10,789
2013
10,860
2014
10,995
2015
11,285

the IIW's ETQ&C programmes on a global basis'. One of its key objectives was to actively examine ways to address the worldwide shortage of welding personnel. The scheme now included more than a third of all IIW ANBs and a quarter of all IIW ANBCCs from outside Europe. This caused Guild to remark, '…interest in the IAB system is global and it is now rapidly becoming a true international system'.

The Institute had achieved some remarkable things by 2010 with the IIW IAB having appointed more than 40 ANBs with 700 associated ATBs worldwide. The IIW IAB ETQ&C system, as a result, offered IIW Member Societies a viable and profitable business platform to work from with an estimated global turnover of USD 25 million a year. In 2010 over 10 000 diplomas were issued for the first time in one year raising the cumulative total awarded by IIW ANBs to almost 70 000 diplomas since the scheme began.

From IIW's point of view, one of the real successes came from the growing involvement of China in the certification of companies, starting with a total of 11 companies certified in 2010. Mr Xie Yinglong, China's IIW ANBCC Scheme Manager indicated the scheme's potential by stating that there were nearly 10 000 manufacturers utilising welding in China.[36] By 2016 interest in company certification had risen substantially with over 350 Chinese companies certified in accordance with the IIW MCS ISO 3834 programme.[37] This had resulted from active promotion and marketing. More and more companies in China were showing increasing interest in becoming certified because of the benefits and opportunities it brought to them in terms of product quality improvement and international trade.

*Xie Yinglong*

This potential for growth was tempered, however, by the ongoing challenge to increase the uptake of company and personnel certification in other international jurisdictions. The reasons for this are manifold, as explained earlier, and are entwined in a system where welder qualification is performed, for example, in accordance with national standards such as AWS, American Society of Mechanical Engineers (ASME), German Institute for Standardization (DIN), American Petroleum Institute (API) and international standards such as ISO and CEN, or through conformity to other countries' manufacturing statutes or standards.

The question of welding inspector certification again came into consideration when the Advisory Group, under the Chairmanship of Costa, reported to the Board of Directors on its work over the period 2013-15 regarding the possible introduction of an IIW IAB

Welding Inspector Certification programme.[38] The question of market need was an overriding issue addressed by the Advisory Group confirming that there were more than 11 000 inspectors holding IIW qualifications and certification that were eligible for certification as welding inspectors. In addition, the group also identified 10 current IIW Member Societies involved in certification activities, of which six were interested in converting to an international system.[39]

The evaluation of other various factors, including risk and liability, did result in the Advisory Group making a number of recommendations to the IIW Board of Directors, including acceptance of the original proposal made by the IAB in 2013 to allow the development of an IIW welding inspector certification scheme. These recommendations were predicated on mitigating certain aspects of IIW IAB policies and procedures including the resolution of other important issues regarding compliance with competition legislation, mentioned previously. In light of discussions at a subsequent meeting of the IIW Board a supplementary email ballot was held and the recommendation for a proposal to proceed with an IIW IAB Welding Inspector Certification system was subsequently approved in 2016.[40]

Demand for IIW IAB qualification and certification still continued despite the lower uptake for qualifications in the Americas. It reached a significant milestone in 2012 with a combined total of more than 90 000 IIW diplomas being issued around the world since the scheme first started, many of them in Europe.[41] The figures for diplomas, issued by the IIW IAB, continued to show an upwards trend (see graph) and by the end of 2015 the IIW IAB network consisted of 46 countries, of which 45 had active IIW ANBs, including 13 of which offered personnel certification. A total of 533 personnel certificates (including new certificates and renewal of certification) were awarded in 2015.[42] In addition, three countries, Angola, Macedonia and Tunisia were in the process of being assessed for authorisation as ANBs in 2015.

Combined, the total number of international diplomas awarded by IIW ANBs between 1998 and 2015 was 124 753, with 11 285 issued in 2015. Of these the vast majority of diplomas were awarded to welding coordination personnel (IWE, IWT, IWS, and IWP) and to a lesser extent to IW and others including IWIP and International Welded Structures Designer (IWSD). In terms of company certification, the IIW IAB by 2015 comprised 26 active IIW ANBCCs that had certified almost 1 700 companies worldwide, including 278 new companies in 2015.

*Olga Teixeira*

The work ethics of those who were employed in the joint IIW/EWF Secretariat at ISQ, including Ferraz and Fernandez, and Mrs Olga Teixeira in administration and finance, were central to the overall success of the qualification and certification scheme. This would not have been achieved without the commitment of all those associated with the IIW IAB, its Working Groups and the many others who contributed to make ETQ&C an unrivalled success. The expectations are that this will continue into the future, a future where new technologies, competition and areas of potential growth will change the welding industry significantly. The fourth industrial revolution is upon us and will see manufacturing undergo a transformation that will leave no area untouched. Manufacturing, in effect, will switch from a mindset of mass production to one of mass customisation. This will require emerging new skills in all areas, including welding and joining, and will be the most important challenge faced by IIW and its ETQ&C scheme in the coming decade.[43]

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chapter 6

# research and innovation

**"Wise men have often said that the closed door keeps out more than it keeps in"**

*Dr Howard Biers, IIW President 1954-57*

*Friction stir welding invented by Wayne Thomas of TWI*

TO UNDERSTAND THE FUTURE ONE MUST STUDY THE PAST. THESE words, to a large extent, explain the continuation of the involvement of IIW in research and development and the effect that welding has had on the progress of the human race, either directly or indirectly, through IIW and the work of its Commissions. Mr Paul Goldschmidt-Clermont (Belgium), the inaugural President of IIW 1948-51, was to stress the importance of the work of the early Commissions by commenting, 'Because it brought together experts in all these subjects IIW had access to a field of observation and studies which were to become, as it were, universal, and it could put the experimental into practice wherever the work units terms of reference was being done'.[1]

Dr Howard Biers, the first IIW President from the USA 1954-57, was also to comment on the purpose of the IIW Commissions regarding research. 'One of the greatest virtues of IIW is perhaps that it provides a mechanism for exchange of information and the stimulation for further research.'[2] He was to add, 'This exchange should be looked upon in its broadest aspects. It means not only the exchange of factual data and experiences, but also of new ideas in the form of hypothesis and suggestions for further research.' Other comments by Biers on the conduct of research included, 'Wise men have often said that the closed door keeps out more than it keeps in'[3] and 'IIW hence, since its formation, acted as a clearing house in which the discoveries of each are put at the disposal of all'.[4]

Mr R.V. Salkin (Belgium) IIW President 1987-1989, was to reiterate what Biers and Goldschmidt-Clermont had said in the commentary he gave on the 40th Anniversary of IIW in 1988. 'The work of the Commissions also constitutes a forum to which the best experts in the world come to make known the results of their work and to bring their contribution to the preparation of survey documents accessible to all.'[5]

It was precepts such as this that the Institute was founded upon, driven primarily through the work of the Commissions, which were defined at the first meeting of Commissions in Delft, The Netherlands in May 1949. In all, there were 12 Commissions which held their first ever meetings at this Assembly. These meetings saw the development

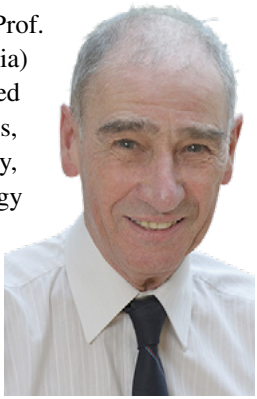
of their technical structure with work carried out in a collective and voluntary capacity.[6] The growing importance of new processes, termed special, such as welding by electron beam, then plasma and later laser, provoked the creation of Commission IV *Special Welding Processes* (C-IV) in Warsaw in 1968, which was to change its name again in 1985 to become *High Energy Density Welding* (currently *Power Beam Processes)* thus placing itself at the leading edge with regard to research activities in the latest sciences involved in the welding of materials.

*Wayne Thomas*

Coming under the auspices of C-IV, by now, were a small number of highly specialised volunteers who pursued a continuous task of adapting the most advanced methods of gathering and disseminating information to the needs of the welding community. These volunteers then formed the basis for a Study Group entitled *Scientific and Technical Information*. Mr Henry Granjon (France) was to commend this Study Group on the 40th Anniversary of IIW in 1988 by saying that, 'from a scientific point of view the collective work within the IIW was considered to have promoted extremely valuable encounters between specialists from all over the world, who now had the opportunity to get to know one another and form mutual relationships, which may lead to collaborative exchange of information on their respective work'.[7]

Commission XII (C-XII) was set up in 1955 under the name of *Special Arc Welding Processes* to encompass gas-shielded and submerged arc welding processes. It had a name change in 1968 to *Flux and Gas-Shielded Electrical Welding Processes* in order to avoid any confusion with the activities of C-IV, which had become responsible for special welding processes. Semi-automatic gas-shielded arc welding processes were rapidly brought into use in many countries during the initial period of C-XII's life.

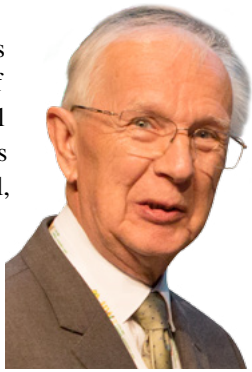
It is now known as *Arc Welding Processes and Production Systems* chaired by Prof. Dr-Eng. Yoshinori Hirata of Japan.[8] C-XII became one of IIW's largest and most active Commissions, particularly under the chairmanship of Prof. Bill Lucas (UK), ably supported by Prof. John Norrish (Australia) and Mr Bertil Pekkari (Sweden). Its sphere of influence extended to the development of more sophisticated arc welding processes, such as controlled power sources, sensor and electronic technology, automation and robotisation, together with computer technology employed in CAD/CAM and expert systems.[9] By 1990 IIW and its Commissions had assembled more of the greatest minds and experts in these fields than possible anywhere else in the world.



*Bill Lucas*

The Annual Assemblies were always the focal point of the Commissions and other Working Units, where decisions were made and discussions held on collaboration and the latest

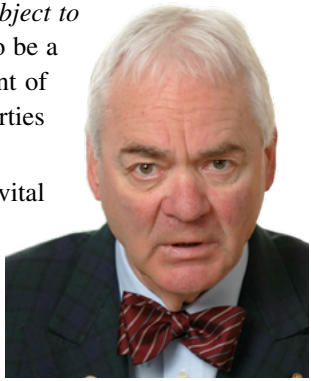
progress of the work undertaken; whether it was research activities and development of the latest techniques, or the dissemination of these findings to the world at large. For instance, at the General Assembly in Montreal in July 1990, a total of 30 documents were recommended for publication in IIW's authoritative journal, *Welding in the World,* on a range of research topics including metallurgical aspects of laser welding, joining of plastics and the application of fatigue test data to welded structures, all of them important in their own right with respect to the latest advances in these areas of expertise.[10]



*John Norrish*

The Montreal International Conference also had a theme that encompassed *Advances in the Welding of New Structural Materials*, which included composites, new metallic materials and ceramics. At the same time, an *International Congress on Joining Research* was organised by the IIW Study Group *Welding Research Strategy and Collaboration* (SG-RES) which attracted 119 people.[11] This was a clear statement of intent that research was foremost on IIW's agenda as it prepared itself for the technological revolution expected to take place over the next 25 years. This became no less apparent than at the next International Conference, *Joining/Welding 2000*, at The Hague, The Netherlands, in July 1991 when robot welding, high energy laser welding and electron beam welding featured highly among the papers presented at the conference.[12]

In 1991, Prof. Horst Cerjak (Austria) and Prof. Dr Kenneth Easterling (Sweden) organised an International Seminar on *Numerical Analysis of Weldability* in Schloss Seggau, a castle in the wine area close to Graz in Austria. This seminar arose from an intermediate meeting of an informal Working Group *Mathematical Modelling of Weld Phenomena* of Commission IX *Behaviour of Metals Subject to Welding* (C-IX). Since then this seminar series has evolved to be a world-leading conference in the growing field of development of methods for the prediction of the microstructures and properties of welds.[13]



*Horst Cerjak*

The Graz-Seggau Conference has proved to be of vital practical and academic importance in the support of computer modelling to help optimise welding processes and consumables as well as the service behaviour of welded components. Held on a biennial basis and attended by leading experts the 12th conference is scheduled for September 2018. The Kenneth Easterling Award for the

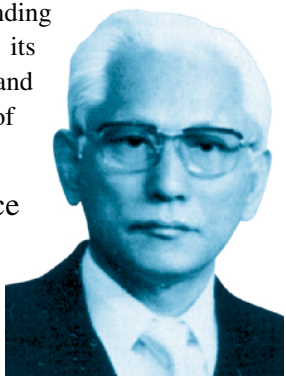
paper on the 'best contribution made over the two preceding years on the advancement of knowledge or practice in respect of mathematical modelling of weld phenomena' is made at each conference in memory of Easterling who was the first Chair of the original Working Group within C- IX.

In the early 1990s a plethora of unique research documents was published by IIW on a diverse range of topics such as laser cutting, guidance on specifications of ferrite in stainless steel welds, and plastic welding directives. This was a time when friction stir welding (FSW) came to prominence after previously being invented by Dr Wayne Thomas at TWI in the UK. Of interest from an IIW perspective was an earlier document on FSW by Thomas that was recommended for publication at the IIW Annual Assembly at Helsinki in 1989.[14] This was a perfect illustration of the research capabilities of a member of the Institute combined with a willingness to share this information through the membership of one of IIW's Commissions.

This was true not only of TWI, but also of many welding institutes which were active members of IIW Commissions, most of which had strong, fundamental, research facilities at the heart of their activities. Indeed, the 1990s was unquestionably an era where welding research had a prominent place in the minds of many of the Member Countries within IIW. In some instances the governments of those countries provided funding to sponsor this research. The Federal Government of Australia, for instance, provided such funding that resulted in a significant impetus for research into the fundamental aspects of welding and the benefits that this would bring to the health of the nation across a broad spectrum of industry.[15] As a result of this injection of funding, Australia became the largest supplier of high-speed car ferries in the world and it also became a leading exponent of microjoining in the production of cochlear implants for the profoundly deaf. This was not done in isolation since other centres of welding excellence throughout the world, allied to IIW, were leading the advances that would improve the quality of life for all.

It was from this profound interest in research that the Henry Granjon Prize was created by IIW, on the initiative of the French delegation, to acknowledge the great service that Granjon had given to the Institute for almost 40 years. In recognition of Granjon's interest in education, the French delegation, in its proposal, insisted that the competition be based on theses written by students specialising in welding.[16] Due to the difficulties in comparing the wide range of topics in this field it was decided to create three different categories for the Granjon Prize, since changed to four, the first of which were awarded in 1992 to Mr Alfredsson of

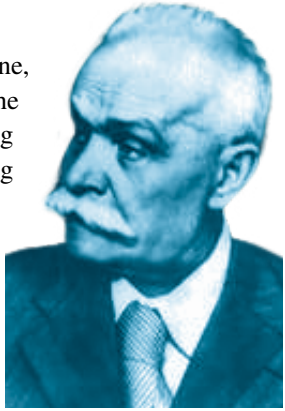
Sweden (Category 1: Design and behaviour of structures), Mr Wangen Lin, USA (Category 2: Behaviour of materials during welding), and Dr Xian, China (Category 3: Welding Technology and related areas). Research became of such importance that several other IIW awards were introduced for outstanding achievements in fundamental research in welding science and its allied processes. These included the Yoshiaki Arata Award and Evgeny Paton Prize for distinguished contribution to the field of welding science and technology.



*Yoshiaki Arata*

The Yoshiaki Arata Award was interesting since it was in commemoration of Prof. Yoshiaki Arata of Japan who was instrumental in setting up and chairing the Study Group *Welding Research Strategy and Collaboration* in 1984 in order to promote international collaboration and interaction.[17] The first Arata award in 1993 was to academician Prof. Dr-Ing. Ivan Hrivnak (Slovakia), Chair of C-IX 1987-93, who pioneered transmission electron microscopy in Slovakia for welded joints.[18]

The Evgeny Paton Prize was another that honoured one of the great patriarchs of welding and was sponsored by the National Welding Committee of the Ukraine for an individual who had made a significant contribution to science and technology through a lifetime of dedication to applied research and development. The first award went to Dr Stephen Maddox of the UK in 2000.

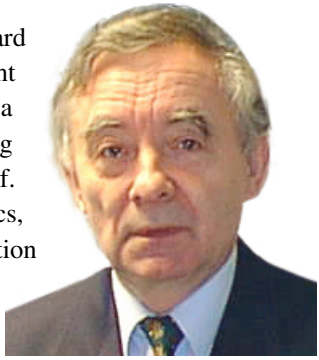


*Evgeny Paton*

The E.O. Paton Electric Welding Institute in Kiev, Ukraine, was one of the foremost welding research organisations in the world and deserves special mention at this point for the outstanding development of Magnetically Impelled Arc Butt (MIAB) welding in the 1990s, a solid phase process for joining hollow sections and circular and non-circular metallic components. Another who epitomised excellence in a lifetime of research was Dr Allan Sanderson of TWI, who stood on the rostrum to receive the Evgeny Paton prize in 2006. Sanderson first started research into electron beam welding when he was a young graduate in 1966. He continued to work on electron beam technology for welding for 40 years including developments in the welding of off-shore wind turbines and was a deserved recipient of the Evgeny Paton prize.[19]

The awards for achievement in science featured prominently at IIW Annual Assemblies, as did the presentation of papers at IIW International Conferences and Congresses on research and innovation in welding technology by leaders in their respective

fields. The Houdremont Lecture, commemorating Prof. Edouard Houdremont (Germany), was an opportunity for an important address at an Annual Assembly International Conference by a distinguished person in a certain field associated with welding and its processes. The Houdremont Lecture in 1994 by Prof. Dr-Ing. Paul Drews from the European Centre of Mechatronics, Aachen, Germany, provided an ideal opportunity to raise attention to latest research developments, including the increasing impact of microelectronics and information technology on welding engineering, as well as the design processes that were substantially influencing the move towards higher levels of productivity, weld quality, flexibility, functionality, operational precision and cost-effectiveness in welding.[20] The Portevin Lecture is also given at International Conferences associated with Annual Assemblies, on alternate years to the Houdremont Lecture. This lecture, also by an invited expert, was established to commemorate Prof. Albert Marcel Portevin (France) who was an outstanding researcher in most areas of metallurgy and a founding Vice-President of IIW.



*Paul Drews*

Many of the microjoining, or microwelding, processes can be traced back to the 1950s when a capacitor discharge machine was introduced for welding of orthodontic appliances. Microjoining received a further boost when thermocompression of wire bonding was developed by Bell Laboratories in 1957. These techniques were the forerunners to microjoining applications commonly used today with processes such as electron beam welding, and having applications in macro-, micro- and nano-scale joining technology because of microjoining's precise beam quality and associated integrated controls.[21] Resulting from such innovations, many important advances in welding technology have subsequently been associated with nanotechnology and the miniaturisation of components and systems, essential for the manufacture of electronic, precision and medical instruments.

Drews' comments were to illustrate that modern welding engineering had now become a synergy of different engineering activities. The past years of manual welding fabrication were now being replaced by automated production processes in many industrial applications including the automotive industry, shipbuilding, aeronautics, construction and the many other activities where eyes, ears and hands, together with the knowledge of the process, and its control, had remained supreme for many years. The first robot welders started to appear in the 1970s to release welding operatives from the hard manual work involved in producing car bodies. Robot welding was relatively new but took off in the 1980s when the automotive industry used robots exclusively for spot welding of car bodies and panels. In

*Increased use of robotic welding in the automotive industry*

keeping IIW interest high in this expanding area, two stalwarts of IIW, Granjon and Boyd, wrote a distinguished book, *Automation and Robotisation in Welding and Allied Processes*, published by IIW through Pergamon Press in 1985. By 2005 around 120 000 robots were being used in the USA with approximately half of them being used for welding.[22]

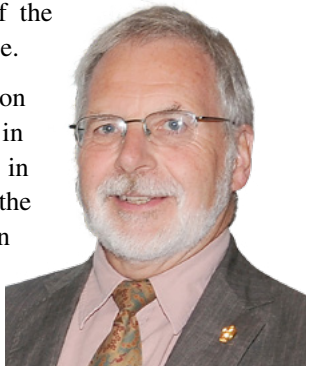
The previously mentioned process of friction stir welding also found increasing application in robotic welding in both the automotive and aviation industries as an innovative technology for the welding of aluminium and its alloys.[23] As well as more exotic techniques, such as laser and electron beam welding, the number of arc welding automatic robot stations increased significantly as the new century dawned, with gas tungsten arc welding (GTAW) (also known as tungsten inert gas (TIG) welding) and gas metal arc welding (GMAW) (sometimes referred to as metal inert gas (MIG) welding or metal active gas (MAG) welding) being well suited to robot systems and their ability to produce high quality welds.

All of this has led to a change of emphasis for many involved in the ways of using modern technology in the design of welding equipment and the adaption of these new techniques in industry. Today, the computer has become a tool used for achieving these purposes and therefore has given rise to a new generation of scientists involved in what is now recognised as a multi-disciplinary approach for the development of new welding processes. This development heralded a new century of information technology, which required special emphasis on how best to utilise the intrinsic properties of mechanical and electronic components in combination with computer control.[24] In his Houdremont Lecture,

Drews discussed the multi-disciplinary approach 'Mechatronics', a term that was to become increasingly familiar within the welding industry and throughout the learning institutions, such as universities, where this new form of scientific endeavour was to achieve greater attention and status.

'All roads lead to Rome' and, ultimately, it was the Commissions, Study Groups and Select Committees of IIW that were empowered and faithful to their core values, both sustaining the development of research and then disseminating this information to both developed and emerging countries, in particular the latter to enable progress to be to the benefit of all. Study Groups and Select Committees drew members from a range of different Commissions, and different countries and backgrounds, and enabled cross-fertilisation of ideas from different disciplines and expertise to focus on specific technical challenges or industry sectors. This concept proved very effective and highlighted the value of IIW's collaborative global model of operation. For many years the activities of these Working Units came under the broad umbrella of the Scientific and Technical Secretariat and a Technical Committee.

With the advent of a new Constitution and the introduction of a more defined planning process in the operations of IIW in 1997, there appeared to be some shortfalls and uncertainties in the communication channels between the Working Units and the Technical Committee. For instance there was some hesitation on which group should have the responsibility of important research activities such as plasma welding, friction stir welding and of course microjoining. As a result Maddox was appointed as a representative on the Technical Committee in an advisory capacity as a link between the two.[25]



*Steve Maddox*

When the group on microjoining first started in 1984, it appeared not to be well attended (the right people were not in the IIW community) and it was officially dissolved in 1991.[26] However, microjoining was to come back into vogue and a Select Committee *Research and Development in Micro- and Nano-Joining Technology* (SC-MICRO) was re-established many years later in 2011 under the chairmanship of Prof. Norman Zhou (Canada) to provide a unique forum for exchange of knowhow and research developments in micro- and nano-joining technologies. The need for such a committee surfaced at a meeting of the SG-RES, in Istanbul on 13 July 2010 following a paper by Zhou on the state-of-the-art of microjoining and nanojoining processes. Zhou then organised a half-day workshop as part of an SG-RES meeting in 2011 and followed this up with the first *International Conference on Nano-joining and Micro-joining*, sponsored by IIW, which was subsequently held in Beijing in December 2012 with more than 100 participants from 10 countries.[27]

It was so successful that a second International Conference was held in Switzerland in December 2014 with further conferences planned on a biennial basis, the next of which

was to be held in Canada in September 2016. Zhou was to expand on the activities of SC-MICRO by saying that it was not only involved in research and development activities but also the transfer of knowledge for the resolution of industrial problems, with a deep involvement in innovative technology.

*Norman Zhou*

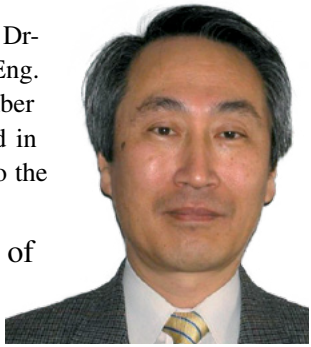
For instance, one of his research students, Dr Ibraheem Khan at the University of Waterloo, Canada, invented a novel technology to embed additional memory and/or pseudo-elasticity into a single piece of shape-memory alloy, based on work on laser welding of NiTi alloys. Such research promised great advances in non-welding applications such as orthodontic wires that deliver optimal forces to each tooth individually.[28] At its 2016 annual meeting it was agreed that the SC-MICRO become a full scale Commission VII *Microjoining and Nanojoining* (C-VII) with a goal to identify, create, develop and transfer best practice in the fields of microjoining and nanojoining.[29]

*Shuili Gong*

Some of the Select Committees established over the period 1990-2010 were focused on industrial sectors, such as Select Committee *Air* (SC-AIR) which had its inaugural meeting in 1993 following a proposal from Prof. Konstantin Yushchenko (Ukraine) for a new working unit on aerospace structures. The work of this committee did not prosper greatly in the interim but was rejuvenated in 2012 with the appointment of Prof. Shuili Gong (China) as Chair, who was a specialist in power beam welding processes in the aviation and aerospace industries. The Select Committee was renamed *Permanent Joints in New Materials and Coatings for Aircraft Engineering*. Another Select Committee focusing on *Automotive and Road Transport* (SC-AUTO) was chaired by Prof. Dr-Ing. Michael Rethmeier (Germany) and had a similar chequered start to that of SC-MICRO and SC-AIR, after it failed to gain traction when it was first launched in 2002. In 2007, a new momentum emerged and SC-AUTO was to become a continuing source of technology diffusion to the transport and automobile industry. Soon after that a Select Committee *Shipbuilding* (SC-SHIP) chaired by Mr Richard Boekholt (The Netherlands), was formed after previously operating as a sub-unit of one of the other Commissions.[30]

The Study Group 212 *Physics of Welding* (SG-212) was formed in 1962 and led by Prof. John Lancaster (UK) until his retirement in 1992, followed by stalwarts Prof. Gert den

Ouden (The Netherlands), Prof. Einar Halmoy (Norway), Prof. Dr-Eng. Yoshinori Hirata (Japan) and more recently by Prof. Dr-Eng. Manabu Tanaka (Japan). SG-212, along with a significant number of other Commissions and Working Units was now involved in research and technology that would contribute significantly to the diversity of research carried out by IIW's Working Units.



*Yoshinori Hirata*

The means of coordinating the activities of research and innovation and disseminating this information to the world at large is, by its very nature, a complex and far reaching exercise. The complexities in doing so markedly affect the products of research and the associated considerations that have to be taken in its application. In light of this, and as a result of organisational changes to the technical structure of IIW, the Technical Committee had been replaced by a Technical Management Board (TMB) some years earlier in 2002. The TMB had the responsibility for the oversight and coordination of the work of all IIW Commissions and Working Units including the general policies and objectives of IIW's scientific research and technical activities.[31]

In understanding the differences between basic research and applied research, the latter involved the practical application of accumulated theories, knowledge, methods and techniques to, in this case, welding science and technologies – the very substance of which IIW's Working Units were ultimately concerned with. Little pure or basic research was done by these groups as it was the province of research institutes and universities like the University of Waterloo (Canada) mentioned previously and other organisations such as the E.O. Paton Electric Welding Institute (Kiev, Ukraine), the Edison Welding Institute (Columbus, Ohio, USA) and TWI (Abington, UK). Other organisations aligned with IIW also sought to explore, discover and develop the outer limits of welding and joining science. Together, this network of experts provided the perfect platform for the furtherance of research and its diffusion to the widest cross section of industry, as well as to the international community.

This was done in many ways, particularly through the presentation of papers at IIW Annual Assemblies and associated conferences and other events, and publication in IIW's official journal, *Welding in the World*. Importantly, the work of the Commissions, Study Groups and Select Committees and the products of their research, more often than not, provided the technical basis for the development of international standards. In this respect, of the 26 Commissions and Working Units in 2011, about one-third was involved in standardisation activities.[32] One should not, in any sense, decry the need to produce standards. Their purpose was often a product of research itself and hence an endorsement of the need to carry out research in the first place. The Commissions from 1990 became prolific producers

of documents, publications and books on their work. By 2014 the IIW's database for technical documents contained almost 15,000 references going back to 1948, a substantive contribution from the many experts from the 56 countries that made up IIW at that time.

The 1990s had, in fact, coincided with a period in which life extension and fitness for purpose became clarion calls for extending the life of critical plant beyond its design life. The fundamentals in doing assessments of this nature were not widely understood and IIW produced an authoritative reference book *IIW Guidance on Assessment of the Fitness for Purpose of Welded Structures*, which was 322 pages in length and served as the preferred reference for many in the engineering community who were concerned with determining the integrity of welded structures.

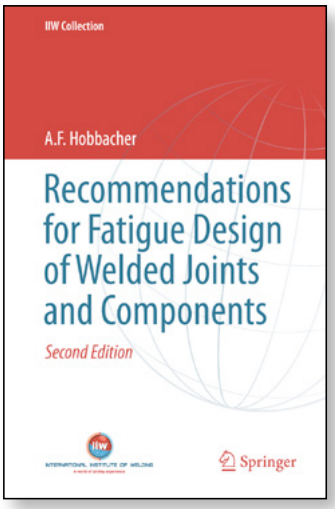
IIW frequently promoted its interest in issues such as this through its conferences, spreading the word, so to speak, and life assessment was to figure greatly at the IIW Conference during the Annual Assembly in Glasgow in 1993 that had as its main theme, *Extending the Life of Welded Structures*. The relevance of life extension in the context of welding advancement was never completely to disappear and the theme of the 2012 International Conference in Denver, almost 20 years later, was aptly *Welding for Repair and Life Extension of Plant and Infrastructure*.

From a different perspective, Commission II *Arc Welding and Filler Metals* (C-II), chaired by Dr Damian Kotecki (USA), was a Commission that used ingenuity and resourcefulness to resolve the lack of availability of standard specimens (secondary standards) for the calibration of instruments to measure the amount of delta ferrite in stainless steel weldments – the previous stocks of specimens having been exhausted due to industry demand. Due to prohibitive costs in manufacturing new specimens, Commission members agreed to participate in a series of 'round robin' tests on centrifugally chill-cast specimens produced by Russia to establish the quality, homogeneity and suitability of these samples for secondary standards. Before production could start the economic position in Russia deteriorated significantly and an infusion of capital of around USD 65 000 was required to finance the project.

Adolf Hobbacher

'Where would Commission II get such a sum of money?' implored Kotecki. 'The solution was simple', he said, following a suggestion by Dr Tad Boniszewski (UK). Commission II wrote letters to the various filler metal manufacturers asking for loans, interest-free and unsecured, except for a promise to repay the loans as soon as possible.[33] 'Would these companies do this?' was the question on many lips. They did, and a total of USD 68 500 was raised from 10 electrode manufacturing companies, plus a donation

from the Nickel Development Association, Canada. The project to produce secondary standard specimens went ahead. The eventual sale of these specimens more than recouped the costs of manufacturing and the promise to pay the loans was honoured. Kotecki was the first to give credit where it was due. 'The whole world of welding owes a debt of gratitude to those who put their funds at risk in this effort.'[34]



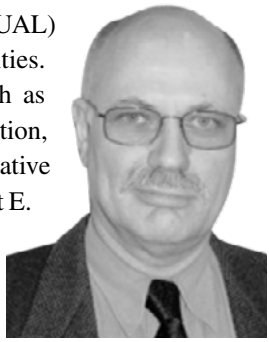

In 1996 IIW published another treatise on *The Fatigue Design of Welded Joints and Components* by Prof. Dr-Ing. Adolf Hobbacher (Germany), which was a joint exercise between Commission XIII *Fatigue of Welded Components and Structures* (C-XIII) and Commission XV *Design, Analysis and Fabrication of Welded Structures* (C-XV). This book was immediately successful and was republished as a slightly larger second edition in 2015.

It was a forerunner to several other books on fatigue of welded structures, including in 2013 *IIW Recommendations on Methods for Improving the Fatigue Strength of Welded Joints* by Prof. P.J. Haagensen (Norway) and Dr Stephen Maddox (UK). In 2010 Commission X *Structural Performances of Welded Joints – Fracture Avoidance* (C-X) chaired by Dr Mustafa Koçak (Germany) also produced an impressive document, *IIW Guidance on Fitness-for-Service Assessment of Weld Flaws*, which became a draft of a Best Practice Document in 2008, later to be forwarded for standardisation.[35] In keeping with the increased focus of fatigue of welded structures during this period C-XIII was also to produce a *Best Practice Guide on Statistical Analysis of Fatigue Data*.[36] All of these documents were judged to be of exceptional importance to industry.

The means of communicating ideas on research, and collaboration between Working Units, was well developed and became more commonplace through the overarching influence of the TMB. A typical example of this was the initiative of C-XII to hold a joint workshop with C-IV and SG-212 at the 2008 Annual Assembly in Graz, Austria, which resulted in an overall attendance of 96 people at the workshop entitled *Effect of Flux and Shielding Gas in Arc, Laser and Hybrid Welding Processes.*[37]

Continuation of good relationships between Working Units was an important part of the development of IIW Guidelines and Best Practice documents. In this respect, Commission VIII *Health, Safety and Environment* (C-VIII), collaborated with Select Committee

*Quality Management in Welding and Allied Processes* (SC-QUAL) to develop guidelines for risk assessment in fabrication activities. This, subsequently, would be of great benefit to industries such as shipbuilding, air, rail transportation, bridges, off-shore construction, automotive and process equipment. Complementary to this initiative was the work also being carried out by C-XV, chaired by Mr Robert E. Shaw (USA), in the design, analysis and fabrication of welded structures. C-XV also had a long history of active cooperation with ISO and other groups working on standardisation and the issues related to weld quality, repair and design.



*Gerd Dobmann*

One must not overlook the importance of the other Working Units which contributed greatly to the stature of welding and joining technology. Commission V *Quality Control and Quality Assurance of Welded Products* (C-V), was fortunate to be headed by Prof. Dr-Ing. Gerd Dobmann of the Fraunhofer Institute, Germany, one of Europe's largest application-oriented research institutes.

Dobmann was one of the foremost experts in fatigue and fracture analysis with an extensive background in all technical aspects of non-destructive testing (NDT), so important in the detection and analysis of flaws in welded structures. C-V also had the challenging task of monitoring, reviewing and contributing to all international standardisation activities relating to NDT and evaluation of welded structures, with more recent work including the completion of the *IIW Handbook For Phased Array Testing*. Without the application of research, provided through C-V, some of the deliberations of many of the other Commissions would more than likely have met extreme difficulties in their final analysis. The development of exact sizing techniques for the positioning and identification of weld flaws in welded structures by C-V was central to much of this work. As another example of the importance of meeting the needs of industry, such as the aircraft and power generation sectors, the IIW TMB formed Commission C-XVII *Soldering, Brazing and Diffusion Bonding* (C-XVII) in 2008 under the able chairmanship of Dr Warren Miglietti (USA).

*Warren Miglietti*

Commission VI *Terminology* (C-VI) played another important part in IIW's Working Units, largely because it provided the basis of understanding for all the terms and descriptions used in welding and joining processes and the

need to have conformity in their use across all areas of expertise in IIW. It entailed a detailed and exhaustive exercise to ensure, from a welding perspective, that everyone was using the correct terminology, whether in written standards, documents, research papers or in any other forms of communication used by IIW Working Units. The importance of C-VI to the other Commissions can be gauged by the fact that it was one of the first set up by IIW in 1948 with the express mandate to compile a *Multilingual Collection of Terms*, the first book of which was for the gas welding section in 1952.[38]

Prof. Pavel Stular (Slovenia) was a stalwart of C-VI and after becoming Chair in 1976 he also took on the role of editor and publisher of the collection, leading to him being awarded the prestigious Edström Medal in 1989. Mr Dietmar Rippegather (Germany), Chair of C-VI 2002-2011, together with Ms Sheila Thomas (UK) with responsibility for IIW's thesaurus, also did outstanding work in the collection of terms obtained from international, regional and national standards in order to avoid the duplication of much work through its multiple language modern databases. Dr Glenn H. Ziegenfuss (USA) was to continue the excellent work of C-VI when he succeeded Rippegather as Chair in 2011.

*Richard Dolby*

Dolby, who became Chair of SG-RES in 1989, was a significant contributor to the early work of this group and was to identify priority areas for research in Europe, for instance, in a period where research funding was problematic. He also highlighted a list of drivers from an industry workshop held in the USA in 1998 that he believed to be appropriate for developing countries.[39] These drivers were leading to specific trends in research and technology needs that had changed in emphasis over the previous five years – changes that research institutes and other research organisations needed to be acutely aware of.

The influence of SG-RES was to be ever constant through the presence of Prof. Dr-Ing. Luisa Quintino (Portugal) who completed three three-year terms as Chair of SG-RES in 2012. The group's main aim was to foster welding research and collaboration between international researchers and this was largely achieved through meetings of the group which occurred each year at Annual Assemblies. These meetings had a significant role in not only collating information about research that was being done by IIW members but also in providing guidance regarding identification for new directions in research as well as the promotion of latest developments through colloquia and other such activities.

Prof. Dr-Ing. Jan Pilarczyk, of the Polish Welding Institute, was another solid contributor to the work of SG-RES and was to emphasise the difficulties of a developing country in conducting research. He highlighted the problems in such countries of obtaining

research funding to assist innovative processes and undertaking technology transfer through collaboration with foreign research institutes.[40] Thanks to membership of the European Union, funding for scientific research in welding was to increase significantly in Poland in 2006, with expectations that this would rise further in subsequent years. The opportunities offered through participation in SG-RES by developing countries such as Poland, such as technology diffusion and access to latest research projects, was a powerful incentive for those countries to join and contribute to the activities of IIW.

*Américo Scotti*

At this stage, in 2006, it was estimated that the volume of the market for welded products was EUR 30 billion throughout the world and that continuous investment in welding research and innovative fields of technology, with increased productivity, were success factors in achieving this phenomenal level of growth in the welding of manufactured products.[41] SG-RES's role in fostering the collation and dissemination of scientific knowledge of welding assumed greater importance from this point on. At the Istanbul meeting in 2010 Prof. Américo Scotti (Brazil) proposed, under the broad umbrella of SG-RES, support for an event titled the European-South American School of Welding and Correlated Processes. In essence this was an event that had, as its objective, the provision of opportunities for exchange and cooperation between researchers on both continents with a longer term view to extend this to other regions of the world.[42]

This was embraced with great fervour by SG-RES and the first event was organised in Ouro Preto, Brazil on 18-20 May 2011, attracting 70 participants from Europe and South America. In looking at current trends in research, one of the most important initiatives taken was the possibility of exchanging young researchers between different countries. Cranfield

*Participants in the first IIW European-South American School of Welding and Correlated Processes held in Ouro Preto, Brazil in 2011*

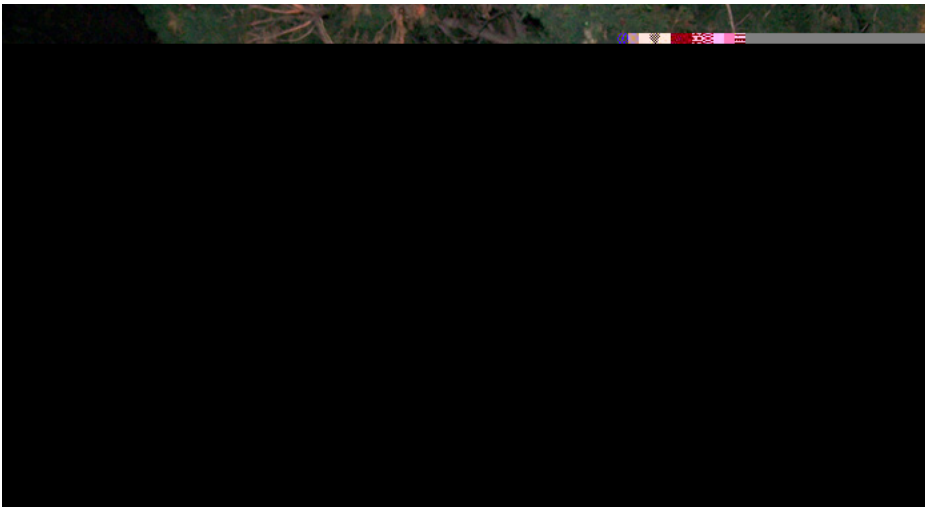
University (UK) was one of the first learning institutes to offer opportunities to research fellows of a no-fees approach for short-term studies in a number of research projects.[43] Such was the great success of the first 'school for welding and correlated processes', invitations were received from several other countries to hold the next school in 2012.

Austria was the successful bidder and in true Austrian fashion the 2nd European-South American school received the plaudits of everyone who attended. The concept, conceived at the Istanbul meeting in 2010, would be the catalyst from this point on for other events such as this. In recognition of the need for a more universal name to reflect the expansion to regions beyond South America, it was decided to change the name to the *IIW Research School of Welding and Correlated Processes* at the SG-RES meeting during the Annual Assembly in Essen in September 2013, with Scotti presiding as the Chair of SG-RES. The research school had become well-established as an annual event.

The next research school was scheduled to be hosted by the WTIA in November 2014 at the University of Wollongong, Australia. In the lead-up to the event, SG-RES agreed to change the name of the school to greater reflect its role and worldwide appeal, thus the 4th school was renamed the *IIW Welding Research and Collaboration Colloquium*. This colloquium had the express intent of acting as a means by which participants could exchange ideas and information and discuss emerging research projects, thus providing the opportunity to generate a network with participating research institutions, resulting in long-term research cooperation, and the building of national welding capability in their respective countries. The 5th IIW Welding Research and Collaboration Colloquium continued the success of these gatherings when it was held in Limburg, Germany, in November 2015.[44]

At a meeting of SG-RES in Denver, during the 2012 Annual Assembly, a presentation was made by Prof. Stephen Liu from the Colorado School of Mines Center for Welding, Joining and Coatings Research on the global economic downturn and subsequent recovery. In this presentation Liu provided interesting statistics on the influence of welding and welding research that assisted both developed and developing countries alike in recovering from the GFC in 2008/9.[45] Some of the areas that had received increased research emphasis in the USA since the GFC were friction stir welding, resistance spot welding, arc physics and residual stress management. The conclusion drawn from the presentation was that welding and joining were the critical technologies that had assisted in redevelopment and growth in countries in the aftermath of the GFC.

Where to now? To improve is very much part of the human condition. Research and experimentation will always be essential in driving mankind along the path of progress that inevitably will take place over the coming years. Welding and joining technologies, as



*Konstantin Yushchenko, E.O.Paton Electric Welding Institute, Ukraine, presenting the traditional welded titanium rose at the Annual Assembly banquet in Croatia, 2007*

always, will play a leading role in advancing the cause of mankind into a future that will be remarkably different to today. At the same time it must be recognised that many countries that have membership of IIW have yet to receive the benefits of the technological gains that developed countries have achieved over the last 25 years.

The implementation of these gains through technology diffusion has been one of the more commendable aspects of IIW's contribution to the sharing of research over this period. The future engagement and encouragement of young welding professionals in research activities will be the source of the next generation of scientists that will serve the IIW Commissions, Study Groups and Select Committees well, keeping welding and joining at the forefront of advances of the human race and helping to prevent declines in the global wellbeing and environment.

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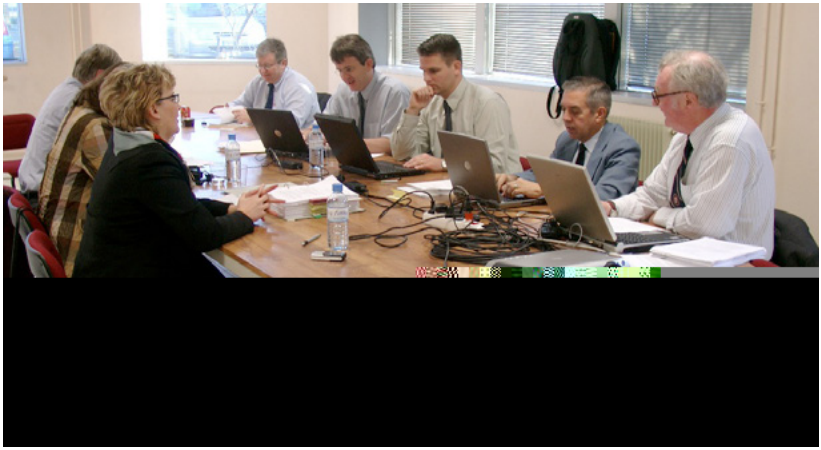
chapter 7

# setting the standard

**“I am going to give you the benefit of my experience”**

*Dr David Shackleton, Chair WG-STAND 1998-2012*



*Interim meeting of the IIW Select Committee Standardisation in Villepinte, France, January, 2004*

STANDARDS HAVE ACCOMPANIED HUMAN PROGRESS SINCE TIME immemorial and a more recent definition of standardisation, with respect to technical standards, is that standardisation itself is the process of implementing and developing technical standards.[1] In consideration of technical standards, the industrial revolution, particularly in Britain, resulted in many innovations and de facto standards that became generally accepted on a national and sometimes international basis. For instance, Whitworth developed the first unofficial national standard for screw threads (BSW) in 1841[2] and Kelvin introduced accurate methods and apparatus for the measurement of electricity in 1857.[3]

The first standards organisation, the Engineering Standards Committee, was set up in London in 1901 and it was not until towards the end of the First World War that national standards committees were established in Germany (1917), France (1918) and the USA (1918). The first international organisation, the International Organization for Standardization (ISO), was formed in 1947 following a meeting in London in 1946 which was attended by 64 delegates from 25 countries.[4] Its formation was almost coincidental with that of IIW, which was officially formed a year later in 1948. IIW's Constitution was to include reference to ISO. One of the three main objectives in the Constitution, upheld at the first Governing Council meeting on 11 June 1948, was to assist in the formulation of international standards for welding in collaboration with ISO.[5]

*André Leroy*

There was some antipathy, initially, between France and the UK, since the latter had been awarded the first General Secretariat, with Mr Guy Parsloe as the General Secretary for a non-specific period of tenure in accordance with IIW's Constitution. Some deft negotiating took place behind the scenes with France gaining increased status and technical control through the appointment of Mr André Leroy as the Scientific and Technical Secretary of IIW in 1950 at the IIW Annual Assembly in Paris. The French delegation withdrew its objections to Parsloe's period of tenure in the constitution and was happy for Leroy, the

Director of the French Institute, to be elected to the new post in the Science and Technical

a standardising body in accordance with ISO Resolution 19/1984 in 1986. CEN concluded its arrangements with ISO by signing this agreement in which CEN was entitled to take into consideration ISO standards wherever they existed, and ISO accepted those documents prepared by CEN to be directly submitted to ISO without a vote for approval by ISO member bodies.[20] This arrangement allowed a standard from either ISO or CEN to be voted on by both organisations simultaneously with one or the other as the lead organisation. CEN had a clear advantage over IIW because most of the CEN members were also members of ISO and therefore voting was numerically in their favour.[21]

The three years following the signing of the tripartite agreement were spent in prevarication and procrastination on the determination of a Coordination Committee to improve relationships with ISO/CEN, plus all the other incidental criticisms and negative comments on rules, competence and authorities. At the SC-STAND meeting in Madrid on 11 September 1992 the proceedings were dominated by a somewhat acrimonious discussion over the rejection of a standard from C-VII, apparently based on political rather than technical grounds. This rejection prompted some of those present to declare no further interest in standardisation. This generated further critical discussion regarding IIW's standardisation programme and the failure to follow ISO rules. In conclusion, it was agreed that the long-proposed meeting of a Coordination Committee should be held between IIW and ISO/TC 44 as soon as practically possible.[22]

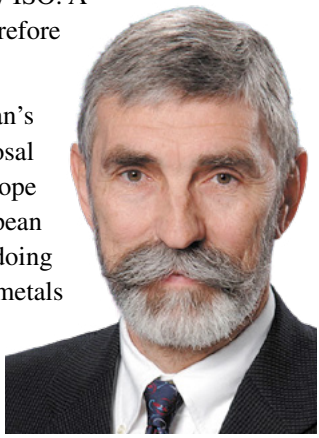
At this meeting SC-STAND agreed to form the ISO/IIW Coordination Committee to decide which organisation would take the lead on any given welding development. This resulted in ISO/TMB Resolution 38/1995 relating to the formation of a Coordination Committee to avoid duplication and fragmentation of work, with a responsibility for the overall coordination and decisions of which work items should be dealt with by IIW.[23] CEN/TC 121 was invited to join as a full member of the committee but declined since it did not want to be bound by the decisions of the Coordination Committee because it had mandated work assigned to it by the European Commission. CEN/TC 21 was offered and then accepted observer status on the committee and this allowed some collaboration and the sharing of documents.[24, 25]

A pivotal meeting was held earlier on 3 December 1992 at the ISO Central Secretariat in Geneva, Switzerland, chaired by Dr J. C. Favre, Deputy Secretary-General of ISO.[26] Based on this meeting the ISO Technical Management Board renewed IIW's tenure as an international standardising body for another one and half years on the provision of a comprehensive report showing that substantial progress had been achieved by IIW in managing their standards programme. This stimulated some progress in the development of

procedural documents covering the rules for voting on IIW standards by the Commissions and IIW Member Societies, as well as a long term strategy for SC-STAND, with Dr Glenn Ziegenfuss (USA) and Dr David Shackleton (UK) both playing central roles in the formulation of these documents. Although gaining acceptance in principle, the process, in view of the pressing circumstances to get important IIW documents approved, was slow and tedious and remained so as measures to resolve the many issues concerning standardisation descended into stagnation and resignation, with no further sign of publication of IIW standards. Describing the problem was a lot easier than trying to solve it.

A fitting example of the frustration and difficulties in getting IIW standards approved by ISO was the review of ISO 2560:1973 *Covered electrodes for manual arc welding of mild and low alloy steel – Code of symbols for identification*, that involved C-II chaired by Dr Damian Kotecki (USA) from 1991 to 2002. After submitting the draft of the revised standard, the ISO/TC 44/SC3 task group detailed a number of amendments to be made to the draft for IIW to consider. After the amendments had been incorporated into the draft the revised document was then approved at IIW's General Assembly in Stockholm in June 1995 and the draft was resubmitted a second time to ISO for approval as ISO/DIS 2560.2.

Again there was a substantial delay in ISO voting on the draft standard which did not begin until August 1998. Although 14 members voted in favour the vote failed to achieve a 75% majority with eight countries, all western European in origin, voting against. According to ISO rules, having failed twice, a complete rework, not a minor revision, would be required before the draft standard could be resubmitted. The dismay from the Pacific Rim countries was expressed in no uncertain terms, particularly by Japan that was opposed to having a revolution in their standards forced upon them by ISO. A revision of a globally relevant standard such as ISO 2560 therefore appeared impossible.[27]



Damian Kotecki

Not to be daunted, Mr Shinsuke Tsutsumi, Japan's representative on ISO/TC 44/SC3, gave voice to a new proposal for a 'cohabitation' standard to solve this domination by Europe of international standards; that is, one path being the European approach and the other based on Pacific Rim standards. In doing so, despite the different classification paths, most filler metals could be classified according to both paths, which could be acceptable to the ISO Central Secretariat.[28] Kotecki was to write two letters to ISO explaining that 'two somewhat different systems of national and/or regional standards for classing filler metals have evolved in the world market.

If one or the other of these two systems were to become the only international standard, there would be a tremendous upheaval (a revolution) in the many fabrication codes and standards that are supported by the filler metal classification standards of the other system'. In a second letter Kotecki was to explain 'The idea is that two paths through a standard be allowed. Specifically, one path would use the system preferred by the countries of the European Market, and one path would use the system preferred by the countries of the Pacific Rim'.[29]

The eloquence of Kotecki's argument elicited a response from ISO which pointed out that 'no ISO policy exists on the concept of "cohabitation" standards. The arguments developed by Dr Kotecki show that in the case like the classification of welding filler metals, such an approach is quite acceptable. Consequently, we would agree with the conclusion of ISO/TC 44/SC3 that a decision be taken on a case-by-case basis'.[30]

The subsequent official reply from ISO, quoting Resolution 179/1999, in January 1999, was '…ISO confirms that it will adopt the principle of "cohabitation" (standards with sets of alternative requirements) for the drafting of international welding consumable standards where a single requirement approach cannot reach consensus'.[31] It was a remarkable achievement through the efforts of both Tsutsumi and Kotecki which had extracted a ground-breaking change in ISO policy.

*Shinsuke Tsutsumi receiving the Thomas Medal from Tom Mustaleski, AWS President, in July 2003 at the 56th IIW Annual Assembly in Bucharest, Romania*

Kotecki was to then engineer the process of approval of the third draft of ISO 2560.3 through IIW and on to ISO/TC 44/SC3 where the standard was unanimously approved with the exception of one dissenting vote. It was finally published on 1 November 2002 after what was termed 'almost 20 years of struggle'. ISO 2560:2002 was not the first 'cohabitation' filler metal standard published, that honour went to ISO 14343:2002 *Welding consumables – Wire electrodes, wires and rods for arc welding for stainless steels and heat resisting steels – Classification*, which was published on 15 February 2002.[32]

This literally opened the floodgates as far as welding filler metal standards were concerned and from that point on publishing of these standards progressed rapidly. This was an outstanding result and Tsutsumi was awarded the Thomas Medal in July 2003 at the 56th IIW Annual Assembly in Bucharest, Romania, for his contribution towards international standardisation of welding consumables. Kotecki, earlier, deservedly was awarded the Thomas Medal in 1999.

Prior to this impasse, which culminated in the acceptance of 'cohabitation' standards, the SC-STAND met on 18 January 1995 and the Chair of the meeting, Evrard, announced that he was resigning as Chair of ISO/TC 44, citing that he strongly disagreed with the position of the ISO Central Secretariat on several issues regarding IIW and recommended his successor, Mr Jean-Paul Gourmelon as Chair of ISO/TC 44. This ended a direct relationship that IIW had with the committee for the last 47 years.[33]

Evrard agreed to remain as the Chair of SC-STAND at the meeting. Shortly after this meeting an ad hoc meeting between ISO, CEN and IIW at ISO headquarters was held on 18 February 1995 to clarify and resolve recent conflicts between the three organisations. The purpose of this meeting was to find solutions to a number of problems regarding cooperation, to enable a final decision on IIW's status as an international standardising body to be made at a forthcoming meeting of the Coordination Committee in May for transmission to the ISO Council.[34] This was made in the affirmative when the Secretary of ISO/TC 44 was to announce an extension of IIW's status for a further five years at this meeting on 18 May 1995 at the Institut de Soudure.

Following the reunification of the two IIW Secretariats, commencing on 1 January 1996 Bramat, the IIW Executive Director at that time, announced at the first meeting of the Executive Council that Mr John Hicks, the previous Secretary General of IIW, 'would be in charge of controlling the standardisation activity of IIW and the drafting of a set of procedures needed to operate the IIW, along with quality assurance principles'.[35] Hicks made a point when he reminded the Executive Council at its meeting in Budapest that he was responsible for the overall administration of standardisation activity in IIW and that he

had revised existing procedures and had drafted a flow chart on how a draft international standard (DIS) should be processed in IIW, ISO and CEN.[36] This was subsequently agreed at a ISO/TC 44 plenary meeting and also at the first Coordination Committee meeting, both of which were held in June 1996. Hicks was an engineer by profession and had been a British delegate and Vice-Chair on Commission XV *Design, Analysis and Fabrication of Welded Structures* (C-XV) prior to becoming Secretary General. His prompt action on producing these documents and engaging quickly with ISO were typical of his temperament and character.

Hicks, Evrard and Bramat attended a meeting with ISO in Geneva on 5 June 1997. It was agreed by ISO that IIW had complied with every intent of the original ISO Resolution 19/1984, but did not exactly correspond to current ISO procedures. Consequently, some of IIW's procedures needed to be further modified. Hicks' forthright manner and the continuing frustrations in dealing with what appeared to be, at times, a rather intransigent approach by ISO on the interpretation of Resolution 19/1984 and other policy issues, in the end was to lead to Ziegenfuss taking on the role as IIW Standards Officer, a position he assumed at the end of John Hicks' contract.

The meeting of the Board of Directors at the San Francisco Annual Assembly in 1997 did have one bright note when it accepted the proposal of the AWS to sponsor a new award, the Thomas Medal for services to standards and Evrard became the first recipient of this award in 1998. The SC-STAND also passed a resolution to request the ISO Central Secretariat to review Resolution 19/1984, which was the source of much angst within IIW, and the current Coordination Committee procedures. Evrard was to retire as the Chair of the Select Committee when his term of office expired at the Annual Assembly in Hamburg in 1998 and was succeeded by Shackleton from the beginning of 1999. It was a difficult time to undertake this role with continuing concerns about delays by ISO in processing IIW standards and corresponding disquiet being directed at IIW by ISO/TC 44 regarding similar delays, which resulted in a request by IIW for the ISO Council to reconsider IIW's status regarding standardisation.

*David Shackleton*

There was immediate improvement in relations with ISO on the appointment of Shackleton as Chair and he was to announce that Ziegenfuss had been appointed jointly as IIW's Standards Officer and Secretary of SC-STAND. The relationship with ISO had reached its lowest ebb at the beginning of 1999 when Ziegenfuss was immediately confronted with serious standards processing problems that threatened the future of IIW's

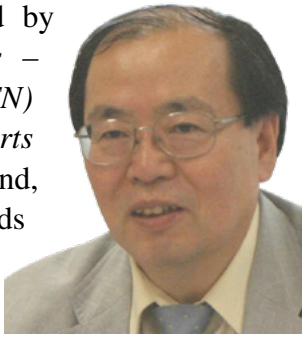
standardisation programme. The threat became more real when the Chair of ISO/TC 44 stated that, unless these problems were resolved quickly, he would have little choice but to recommend the termination of IIW's standards programme.[37] This option was not a consideration and IIW essentially agreed to make the necessary changes to processing standards including acceptance of ISO's insistence on sophisticated criteria for figures used in ISO/IIW standards and the submission of standards in English to Association Française de Normalisation (AFNOR) for translation in accordance with ISO's draft standard rules. Shackleton was to show a highly competent level of diplomacy at the following ISO/TC 44 meeting, demonstrating IIW's commitment to improving the processes between the two organisations. This led to a declaration by Gourmelon, the Chair of ISO/TC 44, that all the problems that had been raised at the meeting had been resolved and that a positive approach had been instituted between the two organisations.[38]

The year 2000 heralded a new dawn as far as IIW's status as an international standardising body was concerned. For the first time, after a hiatus of almost 10 years since 1991, the third ISO/IIW standard, ISO 6847 *Welding consumables – Deposition of a weld metal pad for chemical analysis*, was published in March 2000, followed two months later by the fourth ISO/IIW standard ISO 8249 *Welding – Determination of Ferrite Number (FN) in austenitic and duplex ferritic-austenitic Cr-Ni stainless steel weld metals*, both from C-II, and this time with joint IIW/ISO logos.

Over the next two years a total of 13 standards were subsequently produced, all of which originated from just two Commissions; C-II with eight standards and C-III with five standards, many of which had been queuing up since before 1990. There was some progress on IIW's request for reforms to ISO Resolution 19/1984 but these were of little significance and only amounted to changes for updating the voting times for ballots and little else under the new ISO Resolution 42/1999. The most important result, as far as IIW was concerned, was the agreement in 2001 of the Coordination Committee of its proposal to revise the coordination procedures to add Technical Reports (TR) and Technical Specifications (TS) to the suite of options available for IIW for the publishing of documents through ISO.[39] The potential for doing so was considered to provide a new route for audiences to benefit from the knowledge within IIW. In keeping with this, Shackleton was elected as Chair of the SC-STAND for a second term of three years in tandem with Ziegenfuss, both of whom managed capably with patience and good judgement all the precise details and minutiae involved in their dealings with both ISO/TC 44 and CEN/TC 121.

The breakthrough with 'cohabitation' standards did bring with it a greater degree of trust with CEN/TC 121 which finally joined the Coordination Committee as a full member along with ISO and IIW in August 2006. At this time Shackleton as Chair of SC-STAND, Mr Frédéric Lobinger (France) as Chair of ISO/TC 44 and Prof. Dr-Ing. Detlef

von Hofe (Germany) as Chair of CEN/TC 121 signed an historic agreement between the three organisations for cooperation in international standards. In doing so, CEN and IIW transferred responsibility for many standardisation projects to ISO, establishing a mechanism for sharing documents in development and for the allocation of work to one of the three organisations.[40] At the 2006 Annual Assembly in Quebec, C-II proposed the initiative of transferring the responsibility for all filler metals as Route II drafts to ISO/TC 44/SC3 which was rejected by the SC-STAND, a decision upheld by IIW's TMB which considered that each standard should be treated separately.[41] Ziegenfuss was also opposed to such a move since it represented another means of limiting IIW's authority in the ISO standards arena.[42] Eventually, the responsibility for filler metals involving classification was transferred to ISO/TC 44/SC3 only where justified through SC-STAND, a condition that CEN/TC 121 was also in agreement with.[43] All other filler metals standards remained the responsibility of SC-STAND.



*Kin-ichi Matsuyama*

The first Technical Report to be published by IIW was ISO TR 22824 *Welding Consumables – Prediction and measurement of Ferrite Number (FN) in specifications – A position statement of the experts of IIW Commission IX* in 2004. C-III, on the other hand, was one of the largest producers of welding standards and over the period 1984-1998 had produced a total of 17 draft standards for approval.[44] In one of the significant initiatives regarding solid state welding standards, C-III, chaired by Prof. Kin-ichi Matsuyama, developed the ISO 25239 international series of friction stir welding standards for welding of aluminium and aluminium alloys, starting in 2004 after friction stir welding became part of C-III activities. The work was allocated to a sub-commission of Commission III, SC 3B under the leadership of Mr David Bolser (USA) who had already done a considerable amount of the work required for AWS and through his association and work with Boeing in the development of friction stir welding standards.[45]

Work progressed very quickly due to the depth of experience within SC 3B, including input from Mr David Nicholas and Dr Wayne Thomas of TWI, and the first draft of the five-part series was introduced at the Prague meeting in 2005. The first hurdle to be met was one of patent rights expressed by Japan, which tested the resourcefulness of Ziegenfuss as IIW Standards Officer in the progression of these standards through the respective procedures to the DIS and final draft international standard (FDIS) stages of balloting and voting. No formal procedures or policies had been developed through ISO to account for the consideration of

patent rights in the development of ISO standards. Ziegenfuss prepared an IIW declaration document on patent rights entitled *IIW Patent Statement and Licencing Declaration for the Text of an ISO International Standard*, which was submitted to ISO for consideration in 2006.[46] The issue of patent rights was taken up as a matter of course by ISO, IEC and ITU, the United Nations specialised agency for information and communication technologies, resulting in the publishing of a formal common patent policy by these three organisations in 2007. It was to be a further three years before these patent problems were resolved and the five friction stir welding standards were to move to the FDIS stage for final voting and were finally published in 2011 as ISO 25239 1-5 *Friction stir welding – Aluminium* at an approximate total cost of between USD 1 and 2 million, presumably including also the indirect costs of Boeing's original input.[47] AWS did publish its first standard on friction stir welding in 2009, AWS D17.3 *Specifications for Friction Stir Welding of Aluminum Alloys for Aerospace Applications*.

Participation in standards activity was not strictly the province of C-II and C-III. By 2007, Commission VIII *Health, Safety and Environment* (C-VIII) had standardisation documents in the course of preparation including fume constituents in arc welding. Commission XI *Pressure Vessels, Boilers and Pipelines* (C-XI) was also actively occupied in preparing a document entitled *Creep Crack Growth* and Commission XIII *Fatigue Behaviour of Welded Components and Structures* (C-XIII) also had several technical documents in the course of preparation, including *Retrofitting Engineering for Steel Bridges*. Due to consequential delays in ISO approval for C-VIII proposals, C-VIII eventually had two of these approved as ISO Technical Report documents including ISO TR 13392 *Health and safety aspects in welding – Arc welding* and ISO TR 18786 *Health and safety in welding: Guidelines to risk assessment of welding fabrication*, which were published in 2014. Due to difficulties in gaining ISO approval for other TRs, such as *Welding with Thoriated Tungsten Electrodes* and *Fume Constituents in Arc Welding*, C-VIII therefore decided to publish these as best practice documents.[48]

Much earlier than this, C-XV had one document, *Recommendations for Welded Tubular Joints* well underway for eventual publication as an ISO Technical Report. This was to then become the second such report to be issued when it was published as ISO TR 14347 on 17 November 2008. The Select Committee *Quality Management in Welding and Allied Processes* (SC-QUAL) was also to make a significant contribution to ISO 3834 *Quality requirements for fusion welding of metallic materials*, a standard that was of great importance to IIW's continuing presence in ETQ&C, particularly for those countries taking advantage of IIW's international system. Commission V *NDT and Quality Assurance of*

*Welded Products* (C-V) was also instrumental in the publication of three associated standards on methods of magnetic memory (ISO 24497 1-3) that had originated in that Commission, and were published on 5 November 2007.

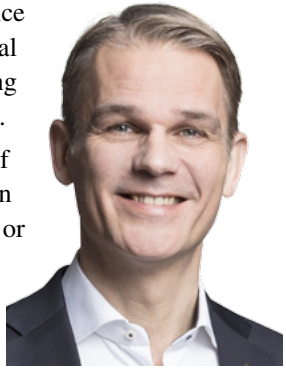
Despite a continuing discourse with ISO on procedural items, including those within IIW itself, there was steady progress almost on all fronts regarding the development of standards and technical reports. At the July 2007 meeting of SC-STAND in Dubrovnik it was announced that the committee would now be known as a Working Group (WG-STAND) under the direction of the IIW Board of Directors. At the same time, Shackleton was reappointed as the Chair of the Working Group for a further three years. During this period, Shackleton was to announce the appointment of a new Standards Officer, Mr Michel Rousseau (France), as a replacement for Ziegenfuss.[49]

Rousseau's tenure was relatively short and he was then replaced by Mr Andrew Davis (USA) from 1 January 2012. In addition to his duties for the AWS, Davis was quick to show his attributes as a highly competent person who had an extensive background in international standards and was soon to establish himself in that position, one that AWS kindly supported from a financial point of view. Ziegenfuss, though, still remained on WG-STAND and was always ready to offer his wise counsel whenever it was needed. Ziegenfuss had a unique record, never likely to be broken, having been continuously involved in SC-STAND, then WG-STAND, since he first began his involvement in IIW standards as the US delegate in 1984, and had participated in every meeting since, a total of 62 consecutive meetings.

*Andrew Davis*

In recognition of this achievement and his outstanding service to IIW in standardisation, Ziegenfuss received the Thomas Medal Award from Mr David Landon, President of AWS, at the opening ceremony of the 68th IIW Annual Assembly in Helsinki in 2015[50].

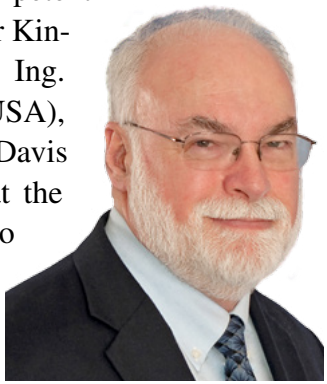
Shackleton, as a long-standing Chair, was very supportive of WG-STAND's role in IIW. 'IIW is only involved in standardisation where it has the technical strength to support international or regional activities.'[51] He added later, in 2011, that '…in scope it has widened its activities greatly including technical reports on resistance welding, friction stir welding and classification of defects in metallic fusion welding. Currently, 35 standardisation projects, including systematic reviews, are



*Mathias Lundin*

being prepared by 10 different working units'.[52] When his final term of office expired, after 14 consecutive years as Chair at the end of 2012, Shackleton was replaced by Mr Mathias Lundin (Sweden).

Lundin's initial bedding-in period was relatively quiet from a technical point of view and had the backing of some highly competent members of WG-STAND including Vice-Chair Mr Kin-ichi Matsuyama (Japan), Mr Dave Fink (USA), Ing. Henk Bodt (The Netherlands), Mr Robert Shaw (USA), Mr Jérôme Dietsch (France), as well as Kotecki, Davis and Ziegenfuss. This was to change markedly at the ISO/TC 44 plenary meeting in Tokyo, held over two days during July 2014, when Germany suggested moving standards just published from Route II to Route I on the basis that the latter did not have target dates, which was considered an advantage for standards that required considerably more research before publication.[53] At this meeting there was an undocumented discussion followed by a resolution proposing to cancel the Route II option for IIW and to transfer all IIW Route II documents to Route I.[54]



*Robert Shaw*

*Henk Bodt*

This was the very antithesis to what IIW had fought for from its earliest days leading up to the approval of IIW as an international standardising body in accordance with ISO resolution 19/1984. Despite the absence of key participants, including Mr Frédéric Lobinger, Chair of ISO/TC 44, Lundin, Chair of WG-STAND and Swedish delegate to the committee, the resolution of ISO/TC 44 (Tokyo 13/2014) was approved unanimously with no dissenting voices.[55] The means of doing this was of great concern since it presented the most serious challenge to IIW's status as a standardising body. Shackleton did say later that apparently the UK was aware that such a discussion would take place even though nothing was raised before the meeting and neither was it on the agenda. His brief was to transfer all Route II standards to Route I but not to end the agreement.[56]

Kotecki immediately sprang to the defence of IIW in a letter to Lobinger as soon as he was aware of the resolution and the outcome that Route II would be cancelled and IIW be retained as a pre-standardising body only, developing Route I drafts as appropriate.[57] In his letter he noted that considerable trust had been built up over the previous 15 years between

ISO, CEN and IIW and taking the current Route II out of the pipeline would violate that trust, a trust that had developed with much hard labour. 'Accordingly, I respectfully request that Resolution 14/2014 be rescinded or withdrawn. The transfer of IIW standards from Route II to Route I should continue on a case-by-case basis with the agreement of the IIW unit concerned.'

Lobinger responded quickly to Kotecki's letter by indicating that he did not attend the meeting concerned and expressed some degree of understanding of the case made by Kotecki. However, it would not be possible, by his own authority, to rescind or withdraw the resolution.[58] Lobinger then proposed to Kotecki that he would organise a meeting with relevant people to resolve the matter and the level of frustration rose. The resolution was also discussed at the WG-STAND meeting in Paris and further dissatisfaction was expressed that the resolution had not been discussed with IIW delegates beforehand nor had it been included in the agenda for the ISO/TC 44 meetings in Tokyo.[59]

This resulted in a letter to the Chair of ISO/TC 44 by the IIW CEO, Dr-Ing. Cécile Mayer, which clarified IIW's position as far as IIW was concerned. In this letter it was further emphasised that IIW was strongly opposed to any change in the current agreement between IIW and the ISO Council. The proposal to cancel Route II as an option for the development of ISO standards within IIW was not raised before the meetings in Tokyo, nor was it on the agenda for discussion at the Coordination Committee, or ISO/TC 44 meetings. Consequently, neither IIW nor its delegations were able to develop positions prior to these meetings.[60]

Subsequently, a meeting of the Coordination Committee was held in Paris with representatives of CEN/TC 121, ISO/TC 44 and IIW. During this meeting agreement was reached between ISO and IIW to supersede the resolution that was approved in Tokyo. It was decided that the agreement that had existed for more than 30 years between ISO and IIW, which had been reviewed several times, should be confirmed as it was.[61] In strengthening further the cause for objection by IIW of the ISO/TC 44 resolution it was emphasised strongly that the recognition of IIW as a standardising body was granted by the ISO Council and therefore ISO/TC 44 did not have the necessary authority to do otherwise on its own account.[62]

In due course a ballot on the questions regarding ISO/TC 44 Resolution 14/2014 was conducted by CEN/TC 121 to resolve this issue at the Joint Advisory Group (JAG) meeting in Helsinki. At the subsequent Plenary Meeting of ISO/TC 44 in Helsinki, the long-standing relationship between IIW and ISO was formally ratified with a resolution superseding the Tokyo resolution.[63] This new resolution was approved by the majority of members with only the British Standards Institute voting negatively. Prof. Dr-Ing. Thomas Böllinghaus

*27th meeting of ISO/TC 44 held in Montreal, Canada, August 2006*

reported, on behalf of Germany, that national meetings had been held and the majority were against the original ISO/TC 44 Tokyo decision.

Essentially, it was decided to review and decide case-by-case, taking into account user benefit, resources and expertise, which route was appropriate for a project; Route I preferably dedicated to the development of international standards and Route II preferably dedicated to the development of Technical Specifications and Technical Reports.[64] This approach was not initially accepted by IIW when the rules of the Joint Coordination Committee were circulated and therefore was likely to be the source of contention in the future.[65] Further clarification of the rules and procedures was planned for early 2017 to avoid such a situation.[66] This whole exercise was what could be termed a 'baptism by fire' for Lundin as Chair of WG-STAND, who went about the process of protecting IIW's position on publication of standards with quiet strength and determination.

The year 2015 concluded sadly with the death of Shackleton, one of IIW's stalwarts who had committed significant effort to the successful development of IIW standards for more than three decades. As Chair of SC-STAND and its successor WG-STAND from 1998

to 2012, he championed the importance of IIW's role in the development of international standards and worked tirelessly to resolve the challenges in processing documents through IIW and on to ISO.[67] He was always ready to contribute his extensive technical knowledge, experience and encouragement and many were fortunate to hear him say 'I am going to give you the benefit of my experience'.

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chapter 8

# emerging nations

**"One of the most important activities of IIW is developing friendship among its members"**

*Mr Mario Agostino Cenni (Brazil),*
*IIW Vice-President 4 April 1992*

*Meeting of the IIW Board of Directors Working Group on Regional Activities and Liaison with Developing Countries in Chennai, India, 2011*

WELDING CONTRIBUTES POSITIVELY TO ALL HUMAN endeavours and the quality of life of all nations. It does this in numerous ways, whether through creating power for lighting and cooking; potable water and safe sanitation; national infrastructure; efficient and effective transportation; accommodation, both for living and working; a multitude of machines for different industrial applications; medical, health and safety devices; or by many other ways. Nowhere is this more apparent than in developing countries or emerging nations where the provision of basic infrastructure and services is critical to the well-being of millions of people.[1]

In its earlier years IIW did not focus on the needs of developing nations to any real extent until the 1980s at least. Arising out of an initiative of an Indian Vice-President, Mr Arumugham, in 1981, it was reported that the Executive Council had formed a Working Group *Liaisons with Developing Countries and Non-Member Countries* and that, via the UITA, contact had been established with UNIDO, the intention being to assist this body with its programmes, in particular the training of engineers and the exchange of information.[2] These contacts had been facilitated through the election of Mr Henry Granjon as interim President of the UITA in 1983/84 and developed rapidly when the IIW made, what could be called, a change in direction when the Executive Council created a new class of 'associate-member' to make possible the participation of bodies ineligible for full membership in non-member countries.

A significant challenge facing IIW was the tyranny of distance from certain regions that precluded their greater involvement in IIW activities, particularly those involving attendance at, or hosting of, IIW Annual Assemblies. In light of this a meeting was held between the IIW President Dr Felix Wallner (Austria), and Dr Irving Oehler (USA), Mr James Bowler (Australia), Mr Mario Agostino Cenni (Brazil) and Mr Chris Smallbone (South Africa). The significant outcome was proposals for the holding of regional congresses and the setting up of regional structures to allow neighbouring countries to collaborate and to have joint representation on IIW's Working Units. Such structures would facilitate the holding of regional congresses, the first of which was proposed to be held in Australia in 1988.[3]

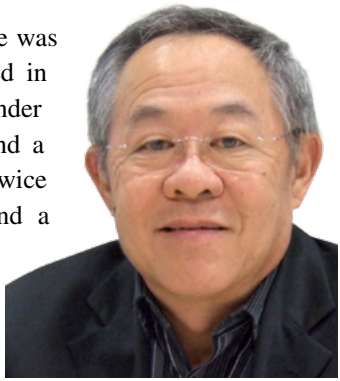
Granjon was to enlarge on these proposals. 'The extension of the list of member countries of IIW all over the world led the Governing Council in 1986 to lay the foundation of a "regional" structure making possible coordination on a wider scale and more active participation in the development of welding within the framework of regions containing several member countries – and future members – which are defined primarily as a function of geographical and linguistic considerations, rather than politics or economics. Preparations are presently being made to set up "Regional Technical Commissions" which in liaison with parent Commissions, and if necessary with the support of Sub-Commissions, will make their own contribution to the work. The organisation of "Regional IIW Congresses" is also envisaged; these will be organised in accordance with their own procedures.'[4]

Conscious of the cost involved in the development of regional interest groups the Secretary General of IIW, Mr John Hicks, was quick to explain the role of IIW with respect to financial support. He was to indicate that '… it is hoped that the authority of IIW will enable countries in the need of funds to make approaches to international agencies to ensure that they can implement the appropriate scheme'.[5] However little was done to build relationships with UNIDO at first. In this respect a deputation consisting of the IIW President at that time, Mr Raül Timerman (Argentina), Hicks and Smallbone representing the IIW regional working group, now known as the Working Group *Regional Activities and Liaison with Developing Countries* (WG-RA), visited UNIDO in 1994 to discuss possible means of collaboration in the funding of developing countries, particularly on the basis of supporting bilateral projects such as the IIW proposed qualification scheme.[6]

This visit was quite successful with UNIDO expressing interest in assisting IIW in developing proposals and also in entering into a cooperative agreement in transferring welding technology to countries in Africa. In doing so the Director General of UNIDO, Mr Mauricio de Mario y Campos, said that 'given the international importance of IIW in all welding activities, not the least the establishment of the relevant ISO standards, and for the certification of welders and welding inspectors, I am confident that the above arrangement could make a very important contribution to the progress of welding in the developing countries of Africa'.[7] A proposal aimed at uplifting welding technology in selected countries on the African continent was subsequently prepared and submitted for funding through sponsorship with UNIDO for implementation in July 1994.[8] Unfortunately, this promising development did not go ahead but later was a forerunner to efforts to provide funding to countries in south-east Europe and elsewhere.

The first regional IIW International Congress in 1988 was an unmitigated success. It was held in the historic colonial port of Hobart, Tasmania, Australia and attracted some 300 participants from 34 countries, eight of which were non-member developing countries

from the Asia-Pacific region. The inaugural Jaeger Lecture was delivered as the opening address at the Congress, named in tribute to the late Professor Hans E. Jaeger, one of the Founder Vice-Presidents of the IIW, IIW President 1951-1954 and a fervent believer in international cooperation. Bowler, twice President of the Australian Welding Institute (AWI) and a member of IIW's Executive Council, was prominent in the organisation of this Congress and in the formation of an Asia-Pacific regional group at a special meeting in Darwin, Australia, in November 1992. Without a champion, activity in the Asia-Pacific region did not progress much further than this until Mr Ang Chee Pheng (Singapore) met with Australian representatives at a welding exhibition in Melbourne and announced that a meeting would be held in Singapore on 7 November 1997 to investigate the possibility of coordinating welding associations in the Asian region.



*Ang Chee Pheng*

Regional congresses, clearly, through dialogue and discussion, provided the fertile ground required for the formation of regional networks. With a strong interest being expressed by developing countries in South America in becoming members of IIW (with Uruguay, Chile and Mexico (Associate Member) taking up membership alongside existing members, Brazil and Argentina), it was only natural that a second regional IIW International Congress be held in Rio de Janeiro, Brazil, courtesy of the Brazilian Association of Welding in April 1992. Cenni, then Vice-President on IIW's Executive Council, in expressing a welcome to everyone attending the event said 'one of the most important activities of IIW is developing friendship among its members'.[9] The Congress proved to be another successful venture and heralded the election in 1993 of Mr Raül Timerman from Argentina as the first person from Latin America to become President of IIW.

The designated third IIW International Congress was subsequently held in New Zealand in 1996 in keeping with the four-year cycle planned for such regional events. Though successful from a technical and social viewpoint it failed to meet attendance and financial expectations.[10] In a post-mortem on the reasons for this, one of the causes of lack of attendance was attributed to poor sponsorship; the other reason because registration fees appeared to be too high. Notwithstanding this, a strongly attended meeting of the WG-RA, including representatives from the AWS, gave further expectations for regional collaboration in the Asia-Pacific region as well as igniting interest in holding international congresses from developing countries around the world.

*Mustafa Hosseinioun, Managing Director of IWREC, speaking at an Iranian IIW International Congress*

In the face of this growing interest, the concept of running international congresses every 4th year was cast aside and Iran was the first to take advantage of this in 1998, when it demonstrated a commitment to becoming more involved in international affairs. In stressing the importance of this event, IIW Treasurer Mr Bevan Braithwaite (UK) and the IIW CEO Mr Michel Bramat, together with Board of Directors member Dr Glenn Ziegenfuss (USA), attended the Congress on behalf of IIW. Iran, interestingly, became a frequent organiser of IIW International Congresses from that point on with a second Congress in March 2002, attended by Braithwaite, attracting over 430 attendees from Iran and 20 from other countries, most of whom presented papers. This Congress, presided over by Dr Mustafa Hosseinioun, Managing Director of the Iranian Welding Research and Engineering Centre (IWREC), was held at Tehran University. A third Iranian Congress was held in December 2003 with over 500 attendees and again generated a commendable international perspective to Iran's welding activities. This was of great assistance to researchers and welding professionals in that country who saw opportunities in showcasing their work and in establishing a dialogue with other welding specialists external to Iran and throughout the region.

Apart from encouraging the formation of regional groupings, the overall focus of IIW was on many other very important matters through the 1990s, such as merging of the two Secretariats, drafting a new Constitution, preparation of a corporate business plan, financial issues and a multitude of other challenges in getting a training and qualification scheme off and running. Smallbone, a newly elected member of the Executive Council and a Vice-President, in 1993 had been given the imprimatur to get the new WG-RA in place. At the Beijing Assembly in 1994 the initial beginnings of this group started to take shape and discussions centred on the implementation of a WeldCare programme, with the international community working closely together to improve the global quality of life through the optimum use of welding technology.

The activities of this group were to progress further by building a firm base from which it could be launched. With the enthusiasm for new initiatives that he was well-known for, Smallbone fought strongly for regional activities to be included in the aims of the strategic planning process, and he volunteered to be the 'champion'.[11] Later, the term 'champion' became an integral part of IIW's vocabulary in describing those willing to undertake a lead role in the strategic planning objectives of IIW.[12]

What were these objectives as far as WG-RA was concerned? The Business Plan on Regional Activities, approved by the Board of Directors in September 1996, stated that the objectives were to:

- complete the formation of an IIW Regional Structure;
- develop IIW services and implement them into the countries in each region;
- have industry in each region utilising the IIW international qualification programmes;
- harmonise IIW's efforts with other organisations' efforts in each region.[13]

The ultimate success of the WeldCare programme would come from hard work in building relationships to provide a positive base on which the concept of regional development could grow. Regional activities, therefore, became more and more a core IIW tenet, particularly with the interest that was starting to develop in the IIW qualification scheme. In this respect Prof. Dr-Ing. Detlef von Hofe (Germany) was to report that DVS, the German Welding Society, had made contact with Cuba, Venezuela and Peru but these countries had little money for participation in IIW. In keeping interest alive in South America, IIW co-sponsored an international welding conference with DVS at the University of Lima in Peru.[14] Mr Germán Hernandez (Spain), who became Chair of IIW's IAB, was also to contribute strongly to IIW's relationships in this region, particularly on matters associated with IIW's qualification and certification schemes. This, no doubt, was eventually to lead to Peru becoming more closely involved in IIW activities and joined as a member in 2011.

It was in South-East Asia, though, that most interest was developing. Singapore, a potential member of IIW, was prominent in the early activities and although enthusiastic, declined the possibility of holding the Asia-Pacific International Congress in 2000 in favour of Australia since it was felt that it was beyond the resources of their recently formed welding society. Singapore, still yet to become a member of IIW, was similarly discouraged from joining IIW, like several other nations in SE Asia, due to what they considered to be high membership fees. The Congress, held in Melbourne from 29 October to 2 November

*Indian dancers at the IIW Annual Assembly, Chennai 2011*

2000, was a watershed in the evolution of these relationships with emerging countries, not just in SE Asia, but in other regions around the world. It was to serve as a model and to define what the real purpose of regional development was all about. That was to identify the needs of the countries in the region and produce IIW supported programmes to help meet those needs, particularly through the efforts of the host country and others in the region.[15]

The President of the Singapore Welding Society, Mr Ang Chee Pheng, was to emphasise this relationship in his keynote address at the Melbourne congress, and the general feeling at the end was that the objectives of the congress had been achieved, especially in relation to developing nations. The overall effect of the congress was to prove positive in encouraging membership of IIW with Pakistan joining in 2000, Thailand in 2001 and Singapore in 2002, with Indonesia and Malaysia joining in 2003 and 2004 respectively. It was also a further catalyst for India to re-join the ranks of IIW in 2004 as a forerunner to a highly successful IIW International Congress held in Mumbai in 2005.

A chance meeting in Copenhagen during the IIW Annual Assembly in 2002 ultimately was to lead to the development of a network for welding technology diffusion throughout the emerging countries in the south-east Europe region.[16] The discussions between Prof. Dr-Ing. Dorin Dehelean (Romania), Mr Adrian Campurean (Secretary of State for Research and Parliament Relations, Romania) and Smallbone resulted in the presentation of a workshop by Smallbone to promote the ideals and concepts of technology diffusion at the same time as the 56th Annual Assembly hosted by Romania in July 2003. The workshop was an outstanding success and was followed up by further workshops, also facilitated

by Smallbone, in Romania, Bulgaria, Serbia and Greece attended by representatives of governments, welding societies and industry from these countries, plus Macedonia, Bosnia and Herzegovina and Montenegro, over the next few years. The ideals of technology diffusion were then cemented into place, with high ranking members from all these countries taking on the role of 'champions' to resource the development of networking in, and between, their respective countries and also to promote the cause of welding technology throughout SE Europe. The results emanating from this collaboration were quite substantial with the foundation of the Romanian Technological Transfer Center in Welding (CENTA-ISIM) in March 2004 and the establishment of an Innovation Centre in Belgrade, both to focus on technology transfer and diffusion activities in that region. The very successful South Eastern European Network (SEENet) was established, linking Technology Support and Education and Training Support Centres with industries utilising welding. The idea for SEENet was taken up by representatives from throughout the region keen to help improve the quality of life. Dehelean was instrumental in this process, along with Welding Society Presidents Dr-Ing. Vencislav Grabulov (Serbia) and Dr-Ing. Marin Beloev (Bulgaria). SEENet was supported by an ever-widening group of representatives from welding societies, government and industry all eager to carry the networking message throughout the region. [17]

In July 2005 a delegation from IIW, including Smallbone, Mr John Zirnhelt (Canada) and Mr James Guild (South Africa), visited UNIDO, the International Atomic Energy Association (IAEA), the European Union (EU) and the UK Department for International Development (DFID) to explore possible project collaboration between IIW and these agencies. This collaboration was, in a sense, an extension of the previous discussions with UNIDO 10 years earlier to fund projects in Africa. This time the discussions with these organisations were done under the banner of a new IIW project 'To improve the global quality of life by the optimum use of welding technology'. The project provided the basis for a number of key activities of the Institute, particularly through the IIW training and

*Representatives from UNIDO, IAEA, DFID and the EU participating in the Technology Diffusion Workshop at the first IIW South-East European Welding Congress, Timișoara, Romania, May 2006*

qualification schemes, and the development of centres of excellence and technology transfer in regions and emerging countries throughout the world.[18]

The strong cooperation and networking between Romania, Bulgaria and Serbia in SE Europe resulted in the 1st South-East European Welding Congress being held in Timișoara, Romania in May 2006, with a theme *Welding and Joining Technologies for Sustainable Development and Environment*. A workshop along similar lines to those earlier was also held at this Congress and attracted additional representation from countries such as Greece, Bosnia and Herzegovina, Hungary, Slovenia, Turkey, Moldavia and Macedonia. Some of these, which were not members already, were to join IIW later and strengthen the membership cause even further. A feature of this congress and the accompanying workshop was the attendance of representatives of UNIDO, IAEA, EU and DFID who collectively gave talks on how these agencies could provide assistance to aid developing countries and economies in the region. The Timișoara workshop was to provide a representative model for future networking of both educational and technology centres of excellence within a region, promoted through the presentation of IIW Technology Innovation Workshops.

The 2nd South-East European IIW International Congress was held in Sofia, Bulgaria, in October 2010. A key objective of this congress was to provide practical solutions to challenges that the region faced, one of which was the construction and diversification of gas pipelines in SE Europe following the disruption of energy services to the EU during 2006-2008. The congress, therefore, was aimed primarily at providing guidance to Balkan countries on modern trends and recent advances in pipeline technology, more particularly because a network of transnational pipelines were scheduled to be built in the region in the foreseeable future.[19]

With the support of IIW Sub-Commission XI-E *Transmission Pipelines* (C-XI-E) and attendance of many of the world's pipeline experts who participated in networking groups, the congress was considered to be an outstanding success. Both Ass. Prof. Dr-Ing. Petar Darjanov and Beloev from the Bulgarian Welding Society played outstanding roles in the organisation and the final outcomes of the International Congress. Building further on the holding of congresses in the region a very successful 3rd International Congress was held in Timișoara in 2015.

*Bertil Pekkari welcoming Brazil to the IIW family*

Mr Bertil Pekkari (Sweden), as President of IIW 2002-2005, placed great

*IIW representatives (from left) Glenn Ziegenfuss, Bertil Pekkari, Detlef von Hofe and Bruno de Meester at the IIW International Congress in Israel, 2005*

*Audience at the opening ceremony of the IIW International Congress in Cairo, Egypt, 2004*

emphasis on increasing IIW's presence in South America and visited Argentina, Brazil, Chile and Peru to encourage participation by South American regional countries in the activities of IIW. This was arranged through a work colleague of Pekkari's from ESAB, Señor Juan Carceres in Argentina. As a result of information exchange and discussions, Pekkari managed to persuade Argentina and Chile to become IIW members and Brazil was to re-join later.[20]

*Dr Cécile Mayer, IIW CEO, with Dr Emmanuel Gyasi (Ghana, left) and Dr Paul Kah (Cameroon) participating in the IIW Annual Assembly, Helsinki, 2015*

In Africa, despite the efforts of the Southern African Institute of Welding (SAIW), it was proving difficult to attract developing nations to embrace the concept of welding improving the global quality of life. At this time only Libya and South Africa were members of IIW. Great faith was placed in the possibility that things may change after the IIW International Congress held in Cairo, Egypt, in late November 2004. The event attracted 230 participants from 27 countries of which 15 were non-member countries from Africa (Benin, Botswana, Eritrea, Ethiopia, Ghana, Guinea, Kenya, Malawi, Mauritania, Niger, Rwanda, Senegal, Tanzania, Uganda and Zimbabwe).[21]

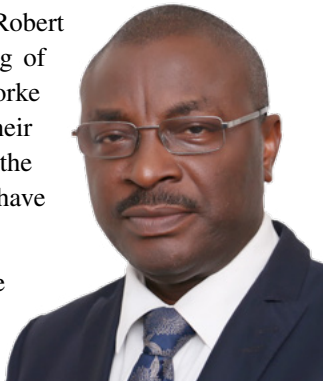
Funding and opportunity, as always, were the key to addressing the problem of improving life on the African continent. Egypt, in understanding this, eventually did become a member of IIW in 2007. Israel, in also understanding the importance of welding to its economy, held an IIW International Congress in Tel Aviv in 2005 illustrating IIW's outstanding impartiality with respect to the ongoing political situation in the Middle East.

Nigeria was what can be called one of the success stories on the African continent. The Nigerian Institute of Welding (NIW) was formed in 1980 and since its establishment underwent several major transformations leading up to the time that it became a full member of IIW in 2006. Up to that point, and since, NIW had relationships with several IIW Member Societies, including AWS, DVS and Gesellschaft für Schweißtechnik international mbH (GSI) SLV-TR in Turkey, SAIW, and the WTIA. Understandably, as a result of this, NIW was considered to be an example for other developing countries in West Africa, particularly through its achievement in becoming an Authorised National Body of IIW's IAB.[22]

*IIW Member SAIW hosted an NDT training course for a group of students from across Africa, supported by the International Atomic Energy Agency (IAEA)*

Through NIW's prominent role as a leader in the attainment of welding technologies it was well positioned to take on the responsibility of becoming a 'champion' for the development of welding expertise and technology diffusion in the region. Ideally placed geographically, at the centre of the oil and gas industry in the Niger Delta, NIW was able to source funding through partnerships with the United Nations and other stakeholders, such as Shell Petroleum Development Company (SPDC), to set up a NIW Centre of Excellence in Welding which, when fully operational, was to provide a full range of facilities in the region, including research, weld testing, non-destructive testing and training.[23]

Nigeria's first IIW International Congress was scheduled to be held in the Niger Delta but because of security problems it was shifted to Abuja, the capital of Nigeria, which underlined the always-present problems that African countries could experience when putting together events of this nature. Mr Robert Shaw (USA) was to graphically illustrate the true meaning of this when a core group from IIW, including Ms Anne Rorke (Australia) and Mr Ernest Levert (USA), climbed into their transport vehicle. Two heavily armed guards then occupied the rear. Shaw echoed everyone's thoughts at the time – 'What have we got ourselves into?'[24]



*Solomon Edebiri*

In willingly taking on the role of 'champion' for the West Africa region NIW, through its forthright President, Dr Solomon Iyobosa Edebiri, was to establish the West African Welding Federation (WAWF) with five countries as pioneer members, in addition to acting as the 'midwife'

*Growth in the number of participants in the IIW IAB, particularly from outside Europe, shows that the IIW education, training, qualification and certification programmes are now part of a truly international system*

in the birth of the Welding Society of Ghana in 2016.[25] In terms of training and qualification, NIW's efforts were outstanding and produced over 400 IIW Qualified Welders, 11 International Welding Engineers, 44 International Welding Inspectors, 9 International Welding Specialists and 44 International Welding Practitioners in the period up to 2012.[26] The training, it must be said, was ably supported by the SAIW which played a key role in the encouragement and establishment of WAWF and in assisting NIW over the short period of time that Nigeria had belonged to the IIW family of nations.

In order to meet the aspirations of many of the emerging nations around the world to become self-sufficient in the training and qualification of welding personnel IIW, through its existing membership, was to respond to these needs through both technical and financial support. Vietnam, conscious of the importance of welding in changing its economy to a modern, technically driven nation, was to see the enormous importance of achieving international recognition and portability for its highly motivated workforce. DVS was instrumental in assisting Vietnam to achieve such an improvement in its capabilities through the establishment of a joint Vietnam-German Technology Transfer and Training Centre (HwC) in Hanoi on 31 March 2006.

Through DVS's authorisation of its facilities and training programmes HwC was entitled to not only qualify welders in accordance with European and international guidelines and standards, but also to qualify International Welding Specialists, Practitioners and

Inspection Personnel according to IIW guidelines. This resulted in a significant contribution to welding in Vietnam and a corresponding attractiveness of welding as a career choice.[27] Vietnam subsequently became a member of IIW in 2007 through HwC as the Member Society.

The role of international congresses during the period 2008-2012 must not be overlooked in the overall scheme of things. The Asia-Pacific IIW International Congress at Tianjin University in China heralded a greater interest and participation in IIW's qualification and personnel and company certification schemes by countries in SE Asia, more particularly China and its fast expanding economy. Similarly, in India, one of the largest attendances ever to take place at a regional event was at the International Congress conducted by India when over 700 delegates attended in Chennai in January 2008. This represented a growing resurgence in interest from the Indian sub-continent as its economy powered forwards in common with other nations across the world. This attendance was eventually surpassed at the 63rd IIW Annual Assembly in Istanbul, Turkey in 2010 when almost 900 participants attended. IIW CEO Dr-Ing. Cécile Mayer expressed the feelings of most who took part, particularly since Turkey, after only becoming an IIW member in 2008, had taken on the Annual Assembly at short notice. 'The Assembly in Turkey will remain one of the most amazing moments of the last 15 years. IIW delegates were treated as honoured guests and the festivities were just outstanding.'[28]

In terms of a developing interest in the Middle East, IIW supported a welding conference in Damascus, Syria, entitled *Development of Welding Technology in the Arab World* which focused on the need to develop welding skills in Syria, Jordan and Lebanon. Its impact was not immediately apparent but nevertheless important in terms of encouraging such countries to join IIW and share the benefits that membership of IIW could bring. The membership of IIW from the African continent, as a result of a number of events and initiatives, would eventually swell to a core membership of Algeria, Angola, Cameroon, Egypt, Libya, Morocco, Nigeria and Tunisia by 2015, including, of course, South Africa, an original foundation member of IIW. This, perhaps, was one of the most important initiatives in expanding the beneficial influence of IIW in the provision of technical knowledge and technology transfer to countries of growing global importance on the African continent.

The linkages through IIW as a global institution were to grow even further with the signing of a MOU with WorldSkills International in 2006 and, as reported in Chapter 3, this provided the means for young vocational welders to show their skills at an international level in competition. Also, a core group of participating countries within IIW, championed by Dr Zhenying Liu (China), set up an 'Arc Cup' International Welding Competition in 2008 for professional welders with a view to improving the technical skills and strengthen

*Activities at the successful third 'Arc Cup' International Welding Competition, Beijing, China, 2014*

the exchange of international welders. The intention was to hold the event every even year in Beijing and at other venues every other year in participating countries.

Since its inception, the 'Arc Cup' has become a platform for international welding and technology and has increased the development and recognition of welding skills in the countries involved in the organisation of the competition (China, Austria, Bulgaria, Czech Republic, Germany, Indonesia, Korea, Mongolia, Romania, Singapore, USA, UK and Ireland). Over 285 welders from 25 countries, including Chinese national enterprises and vocational schools, took part in the 'Arc Cup' in 2014.[29] The event was to gain even further international status as a result of its success and is destined to play an even more important role with the decision, made in Helsinki in 2015, for IIW to support the next scheduled event in Beijing in 2016, with further support in 2017 when the 'Arc Cup' will be held in conjunction with the 70th IIW Annual Assembly in Shanghai, 25-30 June 2017.

With respect to regional activities, the business of attracting young engineers from around the world to the ranks of IIW has been a common cause and was frequently raised in discussion at Annual Assemblies. Dr Baldev Raj (India), for instance, was a devout enthusiast of supporting young people to attend IIW International Congresses and associated events during his period as President 2011-2014. As a result it has become an important

thrust of regional activities to encourage young engineers to attend conferences through the introduction of lower registration fees. IIW, to its credit, also actively supported measures to increase involvement by young people through better promotion to universities.[30]

DVS in particular, having observed over the last decade that the number of personal members had decreased significantly from year to year, was of the conclusion that new blood was needed urgently.[31] To address this situation, DVS implemented changes, mainly within its own jurisdiction, which would act as a model within IIW for individual member countries to promote the recruitment of young professionals and provide incentives to attend Annual Assemblies and International Conferences, as well as to take part in Working Units. Starting this activity in 2009, by offering assistance in attending the 62nd Annual Assembly and Conference in Singapore, the initial results were quite encouraging since it provided the opportunity for young graduates to expand their knowledge of joining technology and to present papers to an international audience. In doing so young engineering graduates had the opportunity to discuss the technical content of their papers directly with luminaries they had known only by reputation before.

It was along these lines that DVS was to argue persuasively for a reduction in registration fees for the younger generation to attend IIW events. At the 63rd Annual Assembly in Istanbul in 2010, 25 papers were presented by young professionals to different IIW Working Units and three to the International Conference itself, resulting in five of these papers subsequently being proposed for publication in *Welding in the World.* By sponsoring young professionals in this way the personal membership of DVS increased significantly in 2011.[32] Primarily a DVS concept, it had immediate application in emerging countries where a large proportion of the population was below the age of 35 years. From this point on, it has been quite noticeable that the level of young people from emerging nations attending and participating in IIW conferences, congresses, colloquia and making poster presentations has risen significantly.

*From left, R. Srinivasan, Arun Bhaduri and Parimal Biswas of the Indian Institute of Welding who play significant roles in the development of welding and IIW in India*

*Record attendance at the 63rd IIW Annual Assembly in Istanbul, Turkey in 2010 when almost 900 participants attended*

The IIW WeldCare programme continued to be the flagship for the promotion of IIW membership to developing countries and the benefits this could bring to various regions of the world, including workshops on subjects such as 'Technology Diffusion' and 'Governance'. These workshops were also held successfully around the world in countries such as South Africa, Nigeria, India, Egypt and China.

In 2013 WG-RA introduced a new project entitled 'Establishing a National Welding Capability (NWC)' as part of its WeldCare programme. With the support of the Indian Institute of Welding, a NWC workshop attended by over 30 senior people was delivered in India by Smallbone as Chair of both the WG-RA and the IIW Task Group *Governance* (TG-GOV). This was part of the third IIW International Congress held in India, in New Delhi in 2014 and assisted in the development of the Indian Institute's 'Welding for Nation Building' project. This was followed by a stream of events as part of the Indian Institute of Welding's 50th year Golden Jubilee celebrations which also included the 6th IIW Welding Research and Collaboration Colloquium held in Hyderabad in 2016 linked in with IIW SG-RES. Dr Arun Kumar Bhaduri, Mr R. Srinivasan and Mr Parimal Biswas, among many others in the Indian Institute of Welding, played significant roles in the development of welding and IIW in India.

IIW Commission XIV *Education and Training* (C-XIV) was a committed supporter of the NWC project and played a key role in assisting and guiding member countries

*Dorin Dehelean of Romania (right) receiving the inaugural IIW Regional Activities Award from John Burnett, President of the Welding Technology Institute of Australia which sponsors the award*

regarding their national capability in implementing IIW education, training, qualification and certification in their respective countries. Besides India's excellent contribution, the members of SEENet also embraced the concept of a NWC following a successful workshop during the IIW International Congress held in Timișoara in 2015, illustrating the excellent global teamwork developed between IIW and its members with a view to extend this project to the benefit of all developing nations within IIW.

International congresses, as a result, are very much a part of IIW and WG-RA's overall strategy and continued to be an excellent catalyst for people from industry, government, research, education and training to work together and to establish networks to resolve issues and foster relationships throughout many regions. These have included the science and technology of welding in challenging situations such as: the tropics; the arid deserts of North Africa and the Middle East; the storms of the North Sea; and cyclones off the north west Australian shelf.

*Marin Beloev*

As an example of tackling challenging environments such as these, IIW and the WG-RA provided typical support for the 1st International Congress on *Welding in the Artic* hosted by the Canadian Welding Association (CWA), when it was held in Vancouver in late September 2014 to address the issues and challenges of working and welding at sub-zero temperatures.[33] In keeping with this, IIW through the WG-RA

also provided support to the Brazilian Welding Association when it covered the more conventional aspects of welding and allied processes at the 1st IIW Pan-American International Welding Congress in São Paulo in October 2014.[34] IIW International Congresses, therefore, were undergoing a subtle change, not only engaging with developing countries, but also in sharing the solutions and the best means of meeting the challenges that emerging nations continually faced in the development of their natural resources and infrastructure.

*Petar Darjanov (left) and Vencislav Grabulov, IIW Annual Assembly, Essen, 2013*

In the acknowledgement of the contributions made by many individuals who have dedicated time and effort in the furtherance of regional activities, the WTIA sponsored an IIW Regional Activities Award in recognition of Smallbone's meritorious contribution to IIW and regional activities over 40 years. The inaugural winner of this award at the IIW Annual Assembly in Seoul, South Korea, in July 2014 was Prof. Dr-Ing. Dorin Dehelean of Romania for his outstanding work in the SE European region.[35] It was an award well-earned and justification of IIW's outstanding efforts to improve the global quality of life for all developing regions throughout the world.

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chapter 9

# health, safety and the environment

**"More and better research is required to clarify bioavailability, unambiguously"**

*Dr Grant McMillan and Dr Vilia Elena Spiegel-Ciobanu, 2015*

*'Cool, clean and clever' – the goal of occupational health and safety in welding*

HEALTH AND SAFETY ARE CRITICAL CONSIDERATIONS FOR ANY application or process involving welding. An array of hazards can be potentially dangerous whether it be in the workplace or danger due to electric shock, exposure to toxic fumes, explosions, fires and other associated causes, such as ultraviolet light exposure and hearing impairment. All of these could be injurious to the health and safety of welding personnel, more particularly the welder who is nearly always in close proximity to the welding operation itself. Welding is intrinsically safe, though, when proper precautions are taken to minimise or eliminate the potential dangers associated with a wide range of materials which can exhibit different characteristics when being welded. It is knowledge of what these dangers are, in order to counteract them, whether they are short or long-term in nature that is so important. The welding industry, as a result, has a long track record of health and safety based on the development of guidelines for safe welding practices and extensive welder safety programmes.

These dangers, with the exception of the long-term damage to health, were recognised in the early days at the turn of the 20th century when both oxy-acetylene and metal arc welding were in their infancy. The necessary protective equipment and clothing, including welder's helmets with eye protection from the arc and foreign particles, were soon introduced along with improvements to welding equipment in the form of flame arrestors and gas regulators for oxy-acetylene welding and similar improvements to electric arc welding equipment to make it easier and much safer to use. The carcinogenic effects of breathing in particles and fumes, however, were not initially understood from a health point of view.

One of the first Commissions set up by IIW in 1948 was Commission VIII *Hygiene and Safety* (C-VIII) with Mr S. Forsman (Sweden) as the inaugural Chair. Since the original Constitution allowed uninterrupted terms of office for Commission chairs, C-VIII was almost unprecedented in having only four chairs over the 45 years from 1948 to 1993, with Mr S. Gerhardsson (Sweden) occupying that role for 25 years from 1964 to 1989, followed by Mr Ingo Grothe (Germany). C-VIII did work particularly hard on health and safety issues in the common cause of welding operatives. In 1984 IIW issued a statement on the possible increased risk of cancer among stainless steel welders. Although not scientifically

proven it was stated that C-VIII would keep this situation under review.[1] IIW also held a very successful *Colloquium on Health and Safety* in 1980 that addressed many of the problems facing the welding industry. Occupational Health and Safety (OHS) was to come under increasing scrutiny in the 1980s with national and local government bodies placing greater emphasis on improving workplace safety through legislation, even to the extent that direct action could be taken in the case of non-compliance, particularly where neglect or omission could be proven.

In many cases, with regards to the long-term effects of welding, the jury was still out and most evidence was either circumstantial or anecdotal and it was easy to deflect criticism on other causal effects. C-VIII was quite active in the 1980s with a number of publications, including *Potential Health Hazards for Welders Involved in Oxy-Fuel Gas Welding, Heating and Cutting*; *Brazing and Soldering*; and *Plasma Arc-Cutting and Welding* prepared by Mr M. Tinkler (Canada).[2] Tinkler, incidentally, also chaired a working group that produced a series of fume data sheets for the various consumables well before the Globalised Harmonized System of classification and labelling of chemicals (GHS) impacted consumable manufacturers. Dr Grant McMillan (UK), a future Chair of C-VIII also published a paper on the *Health of Welders in Naval Dockyards* which was of primary interest to him since he was involved in this area through his position as a physician with the Royal Navy's Institute of Naval Medicine.[3] C-VIII was to become a regular producer of similar documents and papers on health and safety during the 1980s, many of which were published in *Welding in the World*.

An area that did raise initial concern with C-VIII was hardfacing and this resulted in one of IIW's early publications through the issue of fume information sheets outlining the potential hazards and precautions to be undertaken when using arc surfacing materials, welding nickel alloys or nickel-chromium alloy consumables, and when using consumables for welding and brazing cast-iron. These all had varying levels of toxicity during the various arc welding processes. This was one of the first times that guidance documents such as these for hardfacing were issued through IIW for the use of the welding industry.[4]

Grant McMillan

IIW, through C-VIII, in conjunction with the Lindholmen Industrial Development Centre in Göteborg, Sweden, also set up four workplaces for manual arc welding in 1990 whereby a variety of equipment was used to obtain a practical understanding into the improvement of the welder's work

environment.[5] This provided assistance to companies in the development of their own welding workshops and enabled the testing of different types of welding equipment available on the open market. It was the first initiative in Sweden to assist local companies in the selection of the most appropriate welding equipment and associated plant to minimise the risk to the health and safety of welding operatives, including consideration of danger to the health of other personnel working nearby. In this respect, flexible screens and fume extraction was in common use in fixed workplace situations but not in general industry, where welding often took place at non-stationary workplaces. There was also an interest in workplace design and the ergonomics of welding in this period balanced by demands for greater productivity in welding. For a long period, Prof. Dr-Ing. Roland Kadefors of the National Institute for Working Life in Göteborg, Sweden did a considerable amount of work on this and published many papers in the scientific literature. Information became readily available for example on studies of this nature through C-VIII.[6]

Because of statements of cancer risk in welders many studies had been completed by 1993 and it was concluded from the balance of these findings by C-VIII that welders, as a group, had a slightly higher risk of developing lung cancer than the general population and the risk, though slight, could not be neglected.[7] Dr Wolfgang Zschiesche (Germany), who was a medical doctor and long-standing member of C-VIII and became Chair in 2015, was to add that '…the studies do not show welding processes in general, or of a specific type, to be a definite cause of the increased cancer risk.

*Wolfgang Zschiesche*

Having said that, in some welding situations there is a potential for the fume to contain compounds of nickel, and or nickel/chromium that are known to cause cancer in processes other than in welding'. In recognition of this and the need to draw on knowledge from past experiences, C-VIII issued a statement in 1992 to all those responsible for health and safety of welders, calling on them to identify the constituents of the welding fume, reduce exposure to meet national standards, reduce exposure to chromium and nickel compounds in the fume and prevent exposure to asbestos. It was recommended to control exposure through the correct application of operational parameters, such as ventilation, personal protection and welder training, as well as encouraging and assisting welders not to smoke cigarettes.[8]

The wording of this statement confirmed that reliance on anecdotal evidence alone, without greater medical knowledge and the development of correct precautions, could

mean that the unknown, long-term effects of welding on the health of welding operatives became a serious problem. This was particularly significant in the developing countries where combating this problem would be less certain due to lack of understanding, both from a medical and technical viewpoint, and poor training and communication. IIW was to take advantage of its present status to aggregate and disseminate information such as this on all aspects of health and safety in welding and its allied industries. In addition, it was well placed through its authority to provide information on all aspects and safety to the welding world and also to governmental and legal authorities.

Alongside the role that C-VIII had to play in collating all this information on possible causes of health impairment in welders, a considerable number of studies were already being carried out around the world to determine the effects of welding on a range of medical conditions. Sweden, in particular, as well as playing a significant role in C-VIII, undertook an epidemiological study of almost 50 000 welders for 29 years, which found that exposure to welding fume did not support a relationship between welding and Parkinson's disease, or any other degenerative neurological health problems.[9] The study, which was funded by the European Union, was also supported by a similar study in Denmark that did not find any association between welding and Parkinson's disease.

A study commissioned by the AWS also found that welders did not have a higher risk of Parkinson's disease than the normal population.[10] Also, a similar disorder, manganism which was almost identical to Parkinson's disease, was commonly attributed to being associated with the presence of manganese-containing particles in fumes from electric arc welding. The wisest approach, as expounded by McMillan and C-VIII, was to act with vigour to reduce exposure and monitor the effectiveness of this additional protection whilst conducting, at the same time, high quality research to allow sound conclusions to be drawn on the association between manganese and neuro-toxicological disorders.[11] This culminated in the release in 2005 of an *IIW Statement on Manganese* by the Board of Directors summarising the evidence from scientific literature and making recommendations for the control of exposure and future research.

Through its panel of experts, C-VIII was to be faced with a plethora of information from medical studies around the world during the 1990s including health risks associated with brazing and soldering[12] and the influence of hexavalent chromium and manganese which, when it is breathed in, can bypass the normal body defence mechanisms resulting in damage to the lungs, kidneys and the central nervous system.[13] Hexavalent chromium was, and still is, considered to be an occupational carcinogen in this form that can attack lungs, nasal and sinus cavities.[14] This was not confined to welding per se but could be

found in many other industries such as electroplating, chemicals and in primary industry due to airborne particles caused by crushing and grinding of ores containing chromium and manganese. Like asbestos, these particles could travel long distances and affect the community at large. It was also considered a cause of chronic bronchitis in welders due to fine ingredients of chromium and nickel in welding fume from welding stainless steel.[15]

As a result, IIW was faced with sometimes conflicting evidence in the literature, including inconsistent conclusions along with limited data on biological processes that might result in given health outcomes. Together with the complex nature of mixtures of fume components, these issues required remarkable insight by the group members. This lack of corroboration of absolute proof is as relevant today as it was in the late 1990s when C-VIII was to take on in greater earnest its remit to resolve the complex issues of health and safety in welding and to advise industry on the ways and means of solving these issues, or reducing risk to negligible levels.

IIW was fortunate in the appointment of McMillan as Chair of C-VIII in 1997. McMillan was an occupational physician and became an Honorary Senior Lecturer in Occupational Health at the University of Birmingham (UK). In addition he had the distinction of being an Honorary Physician to Her Majesty the Queen from 1996 to 2004. He was, therefore, well versed in the medical aspects of OHS in conjunction with fine leadership characteristics and a determination to resolve the intertwined nature of the health issues that faced the welding industry. His chairmanship started a move by C-VIII to a much closer relationship with other Commissions and with the welding world.

Prevention rather than proof was more important at this stage and C-VIII was to work consistently in the development of best practice documents that improved the working environment of welders and reduced the element of risk to their health and safety. The first of these was a statement on *Welding and Cutting Containers* followed in quick succession by *Welding Adds Hazards* to *Work in Confined Spaces* and *Health Hazards from Exposure to Electromagnetic Fields in Welding*.[16] The final two documents produced during McMillan's first term of office were aimed specifically at health issues and included *Fume Composition Related to Welding Processes and Consumables* and *Welding with Non-Consumable Thoriated Tungsten Electrodes*.[17] These best practice statements came from debate and discussion between the members of the Commission and often included details sourced from scientific papers.

McMillan was to express his feelings with regard to C-VIII. 'Wouldn't it be wonderful for there to be a forum which was recognised internationally and throughout the welding and joining industry as a place where a cross-section of well-informed people from

that industry and associated academic establishments could meet, free of special interest pressures, to share their knowledge and experience. There they could be tasked to consider new technological developments, debate the validity and conclusions of scientific reports on health and safety risks on these and established processes, to seek a consensus view and advise everyone in the industry on their best assessment of levels of risk and how these might be managed most effectively and efficiently.'[18]

This statement encapsulated the ethical and motivational considerations of the work undertaken by C-VIII in its entirety. This group consisted of leading experts from around the world, with growing numbers coming from developing countries, including academicians or experts prominent in health and safety. In addition to members already mentioned, and although too many to list here, the group included Prof. Peter J. Hewitt of the Metal Fume Research Unit, University of Bradford (UK); Prof. Yoshihiro Yamaguchi (Japan); Mr Ken Brown, The Lincoln Electric Company (USA); Mr Steve Hedrick (USA), as well as standardisation expert Mr Mathias Lundin (Sweden), and Mr Daniel Beaufils (France) who later would become CEO of the IIW Secretariat. Dr Vilia Elena Spiegel-Ciobanu (Germany), originally from Romania, was also another productive member of the Commission and often presented results of research work into health issues caused by hazardous fume substances in welding.[19]

On finishing his first term as Chair of C-VIII in 2000, McMillan announced his resignation from the group indicating that changes in his new work assignment made it difficult to fulfil his duties as Chair. Beaufils fulfilled this role in the meantime as Acting Chair but indicated that his new appointment as CEO of the IIW Secretariat would also preclude him from future involvement as a Chair of C-VIII. McMillan then agreed to continue the duties of the Chair of C-VIII at its meeting in Copenhagen in June 2002. At this meeting it was announced that 'Dr Kohyama from Japan was to take over as delegate at the end of the meeting from our long-serving and esteemed colleague, Professor Yamaguchi'.[20] Yamaguchi had chaired a working group, mainly Japan-based, on optical radiation that produced a number of documents on hazards and preventative equipment for ultraviolet, visible and infrared radiation in welding. Yamaguchi, as a young medical technician, was one of the very first persons to enter radioactive areas in Japan to assist victims of the blast after the atomic bomb was dropped on Japan in 1945.[21]

With respect to a parallel initiative in health and safety, discussions did take place at a Board of Directors meeting in San Francisco in July 1997 to identify aspects associated with IIW's objectives towards achieving a sustainable environment. Mr Bertil Pekkari (Sweden) was to champion the cause of the environment. Following a further meeting of the Board

of Directors in July 1999 a resolution of the General Assembly approved the creation of a Select Committee *Environment* (SC-ENV) to encompass such issues. The first meeting of this committee took place at the Annual Assembly in Florence on the 10 July 2000 with an attendance of 15 people and Dr Mauro Scasso (Italy) took on the position of Chair, an action that was confirmed at the next meeting at the Annual Assembly in 2001. SC-ENV's first actions were to draft its terms of reference and to elicit comments from all other Working Units regarding their views on environmental issues, as well as to have direct liaison with C-VIII on health and safety issues. Eventually, SC-ENV was amalgamated into the activities of C-VIII in 2007 which became *Health, Safety and Environment*. The environment was an issue that all Commissions could contribute to through promoting the minimisation of failure rates of welds, better weld inspection and assessment, extending the life of structures, reducing the use of raw materials, and energy savings by more efficient fabrication procedures. For instance, changes in welding consumables and technology had already resulted in a considerable reduction in emissions from welding between 1960 and 1990.[22]

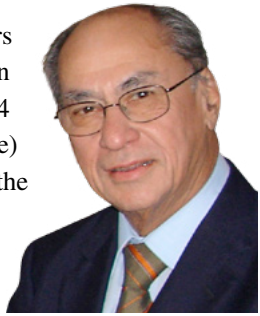
The debate on thoriated tungsten electrodes for TIG welding, supposedly due to the content of thorium in the fume, and the effects of arc welding of mild steel and stainless steel, continued in some depth at C-VIII meetings in the early years following 2000. In the latter, epidemiological studies of lung cancer in welders underwent critical analysis through the contributions of a number of presenters at the two-day meeting of C-VIII at the Annual Assembly in Copenhagen, Denmark in July 2002. Overall, in the face of continuing uncertainty, the Commission believed that welders should be encouraged not to smoke and every effort should be made to reduce their exposure to welding fume, especially fume containing nickel and chromium VI. The Commission issued a revised statement on this important topic at its meeting in Bucharest in July 2003 and approved a resolution to send this to the Secretariat and the General Assembly.[23]

The vexing question of thoriated tungsten electrodes and the effect of their constituents in fumes still remained unresolved although the Swiss delegate informed the meeting that all thoriated tungsten electrodes would be banned in Switzerland from the beginning of 2004.[24] Subsequent studies would provide evidence that oxides of thorium were only present in very small quantities in the arc and the exposure times were invariably small, not sufficient to be injurious to the health of the welder. The ingestion of particles into the respiratory system was attributed mainly to the grinding of the tip of the electrode to maintain the correct profile for optimum welding conditions.[25] The definitive answer as to whether or not cancer could be caused by the use of thoriated tungsten electrodes was still open in 2004 and its resolution by C-VIII was still pending. Denmark was also to join Switzerland in banning the use of tungsten electrodes containing thorium.

*Examples of abuse of the health and safety of young people*

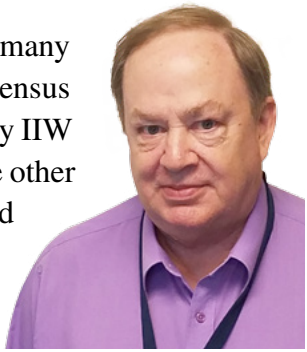
The meeting in Bucharest was unique in that a joint seminar was held with researchers from the host nation on occupational health aspects of welders in that country. It was a means of providing technology diffusion to a Member Country of IIW in much the same way as the Working Group *Regional Activities* (WG-RA) was operating. As a consequence of visiting and providing assistance to developing countries it was quite common for IIW members to see exploitation of child labour and the total lack of consideration for the safety of young children working in welding.[26] This was of particular concern to IIW. The strengthening of ties with under developed nations was encouraged along with cultural change to eradicate child exploitation in countries where this was manifest. Education was the key to this and was a constant theme employed by the Chair of WG-RA Mr Chris Smallbone (Australia) in presentations to national and international audiences. Technology transfer, therefore, needed to be done with a certain degree of sensitivity to the social and economic restraints existing in these countries.

Attracted by low labour costs and sometimes different regulatory regimes, transfer of heavy engineering work to developing countries, in Europe and Asia, had become more common from 1990 on. As a corollary to the lack of a safety culture and structure in such countries, risk assessments of welding conditions were more likely not to be undertaken.[27] The potential for 'pollution exporting' to such countries, through the building of polluting factories there, was also considered to be problematic and unacceptable, as were companies not controlling the risk to the workforce through the use of their consumables, or their products. IIW had set up the SC-ENV, mentioned previously, as a focus for these companies and other interested parties, to ensure that the correct processes were followed in engaging with developing nations through optimum use and innovation of welding and joining technologies.[28]



Richard Boekholt

The newly created tradition of holding scientific seminars with the host country during an Annual Assembly continued in Osaka, Japan, when C-VIII met over two days 12-14 July 2004 with six presentations, including one from Mr Michel Diss (France) and five speakers from Japan, on a range of topics that illustrated the work being undertaken by Japanese researchers. In addition, Mr Richard Boekholt (The Netherlands) presented a report on *The Welder as a Strategic Resource in Shipbuilding*. A finding of this report was that one of the most important reasons for health disturbances and chronic disease in US shipyards was muscular-skeletal ailments, a leading cause in the early retirement of shipyard welding personnel.[29] In an expression of solidarity on this issue the Select Committee *Shipbuilding* (SC-SHIP) expressed a desire to contribute to these studies, with the support of European shipyards, when it was formed with Boekholt as Chair. Later, Kadefors was to inform C-VIII that a project had been set up under the auspices of SC-SHIP to look at the relationship between ergonomics and musculoskeletal health. Mr Glenn Ziegenfuss (USA) also addressed the meeting on standardisation and it was decided that C-VIII would issue technical reports on safety and health topics related to welding, some of which could be used for international standards or publications through IIW's connections with ISO.



Steve Hedrick

At an intermediate meeting in Cologne, Germany in January 2005 it was confirmed that the consensus statement on lung cancer had finally been accepted by IIW and would be published in *Welding in the World*. The other statement on manganese had been modified and had been submitted to the Board of Directors for their approval. There was some urgency in this since Hedrick reported on welding rod litigation in the USA. He indicated that 'thousands of lawsuits have been filed against manufacturers of consumables and equipment in the USA alleging that exposure to manganese from fumes was causing neurological injury'.[30] In a subsequent meeting during the Annual Assembly in Prague in July 2005, Brown was to elucidate further on the manganese problem by reporting that a recent Danish study on manganese had found no excessive degenerative neurological diseases in welders. He also provided updates on progress of Duke University's manganese literary research programme and details of the Harvard School of Public Health Study.

With respect to research experiments on welding fume there were questions regarding the consistency in the methods used for sampling and characterising arc welding fume particles. McMillan was to comment on this by indicating that '...the dynamic physical and chemical nature of welding fume presents challenges to meaningful sampling and analysis and care must be taken to ensure that the results of the analysis actually represents the hazards the welder is facing and have not been significantly altered by the sampling method'.[31]

The problem of manganese and its link to manganism was still a vexing one and galvanised discussions even further by C-VIII in the period up to the end of McMillan's third and final three-year term as Chair. Whilst the C-VIII statement on manganese had not been issued at this stage McMillan discussed his current thoughts on whether manganese was linked to Parkinson's disease, or manganism, both of which by now were considered to be two quite different types of neurological disorder. Based on the low incidence in the literature of manganism being associated with welding, McMillan suggested to the Commission that welders were not apparently at a high risk of clinical damage from exposure to manganese in the fume. The *IIW Statement on Manganese*, included in the IIW 2008 International Conference proceedings, was to reiterate McMillan's conclusions by stating that there is no convincing evidence that exposure to manganese-containing fume carried an increased risk in causing neurobehavioural issues, and that clinical manganism and Parkinson's disease can be differentiated from one another with care and thorough investigation.[32]

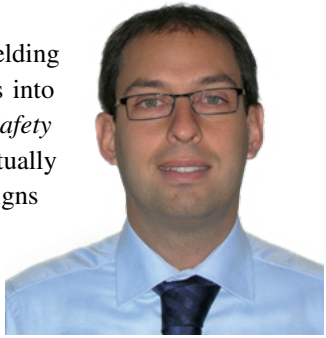
At the end of the meeting Beaufils presented McMillan with a certificate of appreciation for his many years of service to C-VIII and Dr Luca Costa (Italy) was named as McMillan's successor as Chair. It was also announced that Mr Jeffery Sowards (USA) of Ohio State University had been awarded the Granjon Prize (Category IV) for his paper *Method for Sampling and Characterising Arc Welding Fume Particles*.

*Benefiting welders with good fume extraction*

This came at an appropriate time since C-VIII was to hold a joint meeting with Commission II *Arc Welding and Filler Metals* (C-II) regarding a 2nd Round Robin series on the measurement of fume generation rates conducted by ISO/TC 44/SC9 for ISO 15011-4 *Fume Data Sheets* that underlined the influence of arc voltage being set subjectively by the welders. The saga of tungsten thoriated electrodes, if one can call it that, continued with The Netherlands confirming that they had banned their use, and with Japan indicating that they were likely to prohibit their use also.[33]

In review, there was a tremendous commitment by C-VIII to understanding the role of constituents in the fume generated by arc processes and the effect that the constituents of the base metal had on causing potential health problems in welders. One mustn't lose sight of the fact that C-VIII was also involved in many other safety and health issues, such as the effect of ultraviolet light on the eyesight of welders. Optical radiation was assuming greater importance over recent years with the involvement of Dr F. Marini, who at that time was one of the few medical doctors on C-VIII, in a major French study *Vision and Welding*. Other issues of importance to health and safety included welders' exposure to electromagnetic fields and the classification of exposure limits.

C-VIII explored relationships with other organisations such as the International Commission on Occupational Health (ICOH) and had involvement through its members in the Multinational European Project ECONWELD, which looked at aspects of safety and health in such areas as ergonomics, smart helmets with sensors, optimum welder comfort, airflow of helmets, shape and weight of welding torches and gas selection. Welding fume was important but so were a lot of other safety issues impacting on the health of the welder that could not be disregarded. C-VIII, in addition to its wide-ranging brief, was also addressing new areas such as hazards in the cutting and welding of plastics, fibre reinforced polymers and the development of a weldable zinc-free primer.



Luca Costa

The new Chair, Costa, with a background in welding engineering, was also to extend the Commission's interests into other areas with his work on *Guidelines for Health and Safety Management in Welded Fabrications* which was eventually published as an ISO Technical Report.[34] Costa also displayed signs of active involvement across the board when he presented a document on the new European limits and standards for exposure to fume in welding. The first of these two reports resonated substantially with similar work being done by the SC-ENV to create a framework to enable IIW

Working Units to define, quantify and communicate the environmental impacts of welding and related processes for the benefit of the welding industry – the reason for this being the increasing interest in developing countries on the concept of a 'sustainable environment'.[35] Discussions on a merger between C-VIII and SC-ENV, mentioned previously, then took place and a resolution was passed at a joint meeting of the two committees during the Annual Assembly in Dubrovnik, 2-4 July 2007, to combine them and change the name of Commission VIII to *Health, Safety and Environment*.[36]

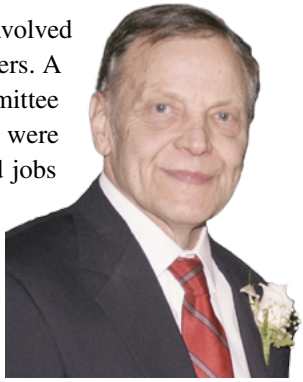
There was a certain degree of reciprocity between SC-ENV and C-VIII since earlier monitoring of Commission activities on the environment by the SC-ENV Secretariat, over a period of three years, showed that only C-VIII had any significant links regarding the environment. This was true in other areas of activity where the two committees had similar interests and had both participated in the activities of CEN/TC 121/WG17 *Environmental Impacts of Welding* that dealt with the production of ISO standards on environment issues. SC-ENV, prior to the amalgamation, was also producing best practice documents such as *Environmental Management in Welding Fabrication*, which was not too dissimilar to Costa's work on health and safety management in welded fabrications mentioned before. This collaboration was to become even more significant through a joint exercise involving Scasso, then Chair of SC-ENV, and Costa and C-VIII in producing the final ISO Draft Technical Report on *Welding and allied processes – Environmental management of welding fabrication* in 2007.[37] The merging of both groups was as inevitable as it was successful.

The activities of C-VIII also involved a joint meeting with Commission XII *Arc Welding Processes and Production Systems* (C-XII), particularly in relation to their interests in welder safety caused by the effects of electromagnetic field (EMF) exposure in arc welding and resistance welding. One matter concerning EMF's status as an important health issue became apparent a short time later when the European Directive on EMF postponed the deadline for the introduction of legislation covering workers' exposure to electromagnetic fields by four years until 2012, therefore dampening expectations that more immediate action would be taken on a developing health issue for both health workers and welders. Costa also initiated meetings with the Chair of C- II, Mr Vincent van der Mee (Netherlands) who also was a long-time member of C-VIII, thus ensuring a high degree of cooperation between the two commissions.

*Vincent van der Mee*

The intermediate meeting of C-VIII held in Gliwice, Poland in 2008 presented some interesting statistics. Firstly, Poland, the host country, in its national report by Mr Jan

Gromiec, revealed that approximately 160 000 people were involved in welding in that country, including 70-80 000 full-time welders. A joint meeting with the ECONWELD Project Technical Committee in Gliwice also revealed even more staggering statistics – there were over 730 000 full-time welders and 5.5 million welding-related jobs in Europe. Welding had a high impact on the health of these workers leading to a high percentage of sick leave estimated at 160 hrs/year for each welder.[38] Brown also presented a brief update on manganese litigation in the USA, commenting that in March 2008, welding electrode manufacturers lost their case in Mississippi but won one case in Louisiana. The plaintiff in Mississippi was awarded USD 2.9 million damages for manganism against three welding rod manufacturers in the Mississippi District Court, by Judge Kathleen O'Malley. In the case of the Louisiana claims the judge took only one hour to dismiss those brought on by four welders, based on the arguments by the manufacturers that they suffered Parkinson's disease and not manganism. The report covering these cases said that 'After consecutive trial victories by plaintiffs, including the one in Mississippi, counsel for the welding rod manufacturers can take a deep breath after a big win in Louisiana'.[39]



*Ken Brown*

Industry was by now recognising the increasing importance of welders' exposure to a number of environmental factors which potentially contributed to chronic health problems among welders. Several shipyards in Europe were participating in a programme following a meeting of SC-SHIP in Odense, Denmark, in September 2003. Boekholt and Kadefors were both instrumental in the support of this exercise and in reporting back to C-VIII on the programme which had as one of its principal aims to keep qualified professional welders on the job up to a normal retirement age. It was now becoming clear that industry faced increasing difficulties in replacing skilled welders and in attracting young people to start a career in welding. This had industry lamenting 'where have all the welders gone?'[40]

Although resolution of health problems in welding and shipbuilding, in particular, were relatively slow at first, there were encouraging signs that creative engineering and research into ergonomics were providing solutions for the minimisation, or prevention, of health issues. Ergonomics was to become a key discipline in cutting out the heavy manual labour involved in welding and consequently the musculoskeletal disorders that were the major cause of early retirement for welders. It ideally fitted into the work of the Multinational European Project, ECONWELD and the many other national occupational health projects around the world. IIW, through C-VIII members, was able to promote and highlight these

advances to an attentive and expectant audience. Some of the advances included the design of a welder gun to increase welder comfort and ergonomic chairs that were designed for postural stabilisation when working in difficult access positions such as overhead welding. The increasing use of robotisation to increase productivity also served to make life for the welder much easier and to counter the shortfall in the occupation rates for welders that had previously been declining significantly.[41]

In 2008 some Member Societies asked, via their delegates on C-VIII, for a means of supporting the welding industry and the inspection and insurance organisations in the identification of criteria for risk assessment and management. Costa and Lundin were to respond to these requests by producing a definitive document on the *Health and Safety Risks in Welding* at the IIW Annual Conference in Chennai, India in 2011.[42] One of the other considered routes for advising the welding public and industry involved the issue of guidelines through ISO Technical Reports. The process of translating the work of C-VIII into the form of international standards and technical reports, though, was inevitably subject to headwinds due to consequential delays in their approval before final publication. Instances of this included the draft ISO TR *Health and safety aspects of welding – Non-consumable thoriated tungsten electrodes*, a publication that still had not seen the light of day by the year 2011. The other instance was the ballot for the draft ISO TR *Health and safety aspects of welding – Arc welding: Fume components related to welding processes and base metals* that was also delayed since it failed to receive sufficient votes at ballot because of perceived conflict with ISO 15011-4. The thoriated tungsten electrode ISO TR document was left to wither on the vine for many years until it was eventually decided to publish this, as an IIW best practice document instead, at the Essen, Germany meeting of C-VIII in September 2013.

Consequently, the *Health and safety aspects of welding – Arc welding* document required further revision and approval through a new ballot process and it was published after much delay as an ISO Technical Report, ISO TR 13392, in 2014. At the same time, a working draft of ISO TR *Health and safety in welding – Guidance to risk assessment of welding fabrication activities* also underwent the tortuous process of review and further approval as the process entered its third year. This work was headed by Mr Chris Abert (Switzerland) who devoted considerable time and effort to developing these guidelines and in the issue of the final Technical Report. Like ISO 13392 it was then finally published as ISO TR 18786 *Health and safety in welding – Guideline to risk assessment of welding fabrication activities* in 2014.[43]

At the core of this important document were the considered concerns on the possible hazards and risks to be encountered during arc welding in order to help welding fabricators to identify counter-measures to minimise risk. In contrast, most ISO standards on health and safety that had been approved to date were on requirements for testing, including methods and procedures for the sampling of fumes.

An antidote to delays, and a less arduous route for providing this information to industry, was through the issue of best practice documents, sometimes called consensus statements. Some of these documents issued by C-VIII, included: *Exposure and the Need for Control Measures*; *IIW Statement on Manganese: Chromium and Manganese in Welding: Exposure and the Need for Control Mechanisms*; *Health and Safety in Fabrication Repair of Welded Components: Aspects, Impacts and Compliance to Regulations*; and *Lung Cancer and Arc Welding of Steels,* all of which were of real importance to the welding industry. The efficacy of producing best practice documents, such as these, came from the authoritative views of some of the best experts in the world on health and safety.

*Martin Cosgrove*

Dr Martin Cosgrove (UK) was a significant contributor on health aspects to C-VIII and his treatise on *Arc Welding and Airways Diseases* was an excellent example of the quality of debate and discussion that were typical of C-VIII meetings. His conclusions, like McMillan before him, were quite succinct '…whilst it is difficult to come to any firm conclusions on the basis of the epidemiological evidence as to whether exposure to welding fumes and gases does or does not cause an accelerating decline in lung function, it seems sensible to take a precautionary approach'.[44] Mr David Hisey (Canada) was another national delegate of C-VIII to provide valuable insight into such areas as electrical safety hazards in welding and, more recently, potential health problems involved in thermite welding.

*David Hisey*

The statement on *Lung Cancer and Arc Welding of Steels* was a perfect illustration of how such a document could be a continuing reference work when it was updated to take into account the latest information when distributed through IIW by C-VIII to IIW's membership in 2010.[45] Attention was focused on studies published since the previous statement that had identified the risk from a number of metal compounds such as iron, nickel and asbestos, as well as ionising radiation and ultrafine particles. The studies

confirmed the previous findings of C-VIII that there was an inherent excess risk of cancer in welders, although the evidence of links to the fume or its constituents was not strong, and that the work environment was likely to increase that risk. As before, exposure to asbestos from sources other than welding and tobacco were causative effects that also contributed significantly to that risk.

*Vilia Elena Spiegel-Ciobanu*

There were still a number of unknowns and a need to undertake further research into likely causes, particularly the health effects of ultrafine particles. This research received greater impetus with the holding of an International Seminar on the *Exposure to Ultrafine Particles in Welding Fume* in Hannover, Germany in February 2009. One researcher who was prominent in the organisation of the seminar, which was held in conjunction with a C-VIII Intermediate Meeting, was Spiegel-Ciobanu, a national delegate to C-VIII for many years, who was instrumental in preparing a best practice document on the exposure of welders to nitrous oxides that could cause serious eye and nose irritation as well as respiratory tract infections. The work of Spiegel-Ciobanu and the Scientific Committee on Occupational Exposure Limit Values (SCOEL), under the auspices of the European Commission, was of primary interest to the welding community and researchers, as were the recommendations to limit or eliminate exposure to nitrogen oxide in fumes and to substantially decrease exposure limits for welders in workplaces.[46]

This topic resulted in considerable debate and discussion by C-VIII on international trends in the reduction of exposure limits in welding fume and the significant number of constituents in this fume. This was particularly true since 2001 when The Netherlands mounted a concerted campaign against a proposed increase in exposure limits. From this point on, under the guidance of Dr David Jordan (UK), the importance of emissions and the identification of hazardous substances in the fume remained a constant focus of the activities of C-VIII.[47] This was especially true for oxy-acetylene and plasma processes, all of which were elements of the best practice statement prepared by Spiegel-Ciobanu for eventual publication by IIW and the *Fume Data Sheets* that were issued by IIW for consideration and advice to the welding community.

From an operational point of view C-VIII was to take an increasing interest in the education and training of personnel in health, safety and the environment and formed a joint working group with Commission XIV *Education and Training* (C-XIV) to progress this further. The IIW IAB had provided further oxygen for this initiative since it had been

considering the development of a document for the minimum requirements for the education and training of International Welding Safety Personnel. In conjunction with this, C-VIII had also issued documentation for *Guidance on Qualification of Environmental Coordinators* within the framework of ISO 14001 *Environmental management systems – Requirements with guidance for use* which, in turn, had adopted the general principles of the ISO 9001 series. This was a signal that health and safety in the environment had come of age, that there was recognition of the seriousness of this and that stricter controls were necessary through monitoring conformance in the field. It was on this note that Costa handed over the reins to the capable hands of Zschiesche in 2014 at the end of an eight-year term as the Chair of C-VIII. Zschiesche had been a contributor and member of C-VIII for many years and had conducted considerable research work through field studies of welders that focused on health hazards of welding fumes. At the start of his first term Zschiesche reaffirmed a willingness to continue the work of his predecessor, intending that the Commission not only focus on its primary function as framework for the exchange of knowledge, but also support the work of other IIW Commissions on occupational health, safety and environmental issues of concern in their own areas of jurisdiction. In this respect, several joint meetings were held with other Commissions during Zschiesche's first year resulting in a number of joint documents under development.

The focus now was to lead IIW forward to meet the new challenges that IIW and welders faced in the fields of health, safety and the environment. These included a multilingual booklet on health and safety as well as a number of best practice statements, such as: *Arc Welding of Steels and Pulmonary Fibrosis*; *Fire Prevention During Hot Work*; *Arc Welding and Airways Diseases*; and *Welding Electrical Hazards*. Some of the 'hot topics' lined up for the future included laser technologies, electrical shock, underwater welding and cutting, polymers, and the effects of welding on female welders, a study currently being carried out in Canada with respect to the unborn child.

In summary, the future work designated for C-VIII has generated an appearance of being just as exciting and interesting as it had been in the past. In doing so it is representative of the contributions of its current and past members, in particular it must be mentioned the contribution of the sterling efforts of Hedrick in his dedicated capacity as secretary and scribe over the last 10 years. Another to feature in the C-VIII hall of fame was Mr John Petkovsek (USA) who was awarded the André Leroy Medal at the 69th Annual Assembly in 2016 for the Lincoln Electric Welding Safety Interactive DVD that was designed to educate electric arc welders about safety hazards. Not to be forgotten

*John Petkovsek*

also was the work of Boekholt in galvanising interest in occupational health throughout the shipyards in Europe and the USA. Boekholt died in February 2010 leaving a legacy of working towards better health outcomes for shipyard welders that had consumed him for many years, work that will be continued well into the future by others of similar intent.

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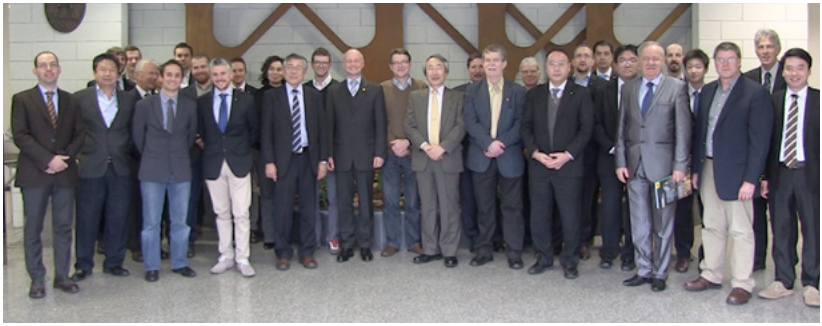
chapter 10

# meeting the challenge – the way ahead

> **"The world can only be grasped by action, not contemplation"**

*Jacob Bronowski*



*Attendees at an IIW joint seminar involving Commissions I, IV, XII and SG-212 in Melbourne, Australia, July 2016*

THE WAY AHEAD FOR IIW, REALLY, IS TO LOOK AT THE ACCOMPLISHments of welding over recent times including the way that welding has transformed the lives of everyone and the promise of a bright future that it will inevitably bring. Infrastructure is one of the key aspects of a nation's development since investment in infrastructure has a multiplier effect in generating lasting economic and environmental benefits. Investment in water, sanitation, energy, housing and transport also improves lives and reduces poverty. Insufficient or inadequate infrastructure can lead to congestion, power outages, lack of access to safe water and roads, inadequate or non-existent health facilities and is a global concern, particularly in underdeveloped and developing countries. Just keeping pace with projected global GDP growth will require an estimated USD 57 trillion in infrastructure investment between 2013 and 2030, 60% more than it cost over the previous 18 years.[1] The inevitable risk is that the difference between rich and poor will become greater, leading to dislocation in socioeconomic relationships and mass relocation from the poorer countries to richer nations for those who are seeking a better quality of life. In meeting that challenge it has been necessary for welding, in its entirety, to be innovative in accomplishing the great advances that have taken place over the last 25 years.

Infrastructure, inherently, has always been the key to sustainable development as evidenced by the great industrial revolution in the 1800s, which led to more cost-effective methods of production and a need for improved transportation to facilitate the movement of goods and materials by land and sea. Welding, associated with advances in materials, was used in the great infrastructure projects of the twentieth century – dams, buildings, bridges, ports, shipping, power stations, and air and road projects.

Welding played an unrivalled role in the development of many of the great industrial nations although welding technology, itself, is often an unnoticed and invisible activity pervading a nation's industrial development. Half the economic wealth of industrialised nations relies directly or indirectly on fabrication techniques using welding and joining technologies. The health of nations is equally important and welding itself has also been instrumental in improving the lifestyle of the overall population with advances in welding techniques for different biocompatible materials in medical devices, such as miniature cardiac pacemakers and surgical implants. It is in this area of microjoining technology that some of the greatest advances in the welding and joining of materials has taken place over the last 25 years.

*Wind power has become the world's fastest growing energy source over the last decade*

A voice from the past, Dr H. Harris of Babcock and Wilcox (UK), was to register welding's importance by saying 'It is permissible for us to proclaim in the most blatant manner possible that, but for welding, modern steam generating plant could not be fabricated, and the most modern power process of all, namely nuclear power, would not have been contemplated had welding not attained the degree of reliability we know at present'.[2]

Although his words were strong in emphasis there is no doubt that power, as a means of providing energy to shape the course of human progress, has changed considerably since Harris made his pronouncement to the IIW Annual Assembly and Conference in Liege in 1960. In the latter years, since 1990, there has been a pronounced shift away from fossil fuel power plant towards renewable and clean energy resources to drive domestic and industrial energy interests.

Hydroelectric power plays an important part in the overall power energy mix. Already, the two largest hydroelectric construction projects, the Three Gorges Dam in China, and the Itaipu Dam on the borders of Argentina, Brazil and Paraguay, are the biggest producers of electricity, far exceeding the outputs of the largest nuclear and coal-fired power stations. While not having the same level of technical challenge as nuclear power generation, the construction of hydroelectric plant required considerable welding expertise from a structural point of view and in the installation of critical generating equipment. Welding challenges, with the application of new materials that have high-strength and

resistance to cavitation erosion, are of ever increasing importance in the construction of the latest generation of hydroelectric power stations. The work of IIW's Working Units, therefore, plays a prominent role in diffusing the necessary welding expertise to the engineering and fabrication industries to assist in the resolution of the inevitable technical challenges existing in major hydroelectric power infrastructure projects. IIW can also advise developing countries on the means of establishing less costly projects through skilling the workforce and providing technical guidance through its membership.

In the 1990s, and right up to the present, IIW maintained a high level of interest in the welding of critical components in coal-fired power stations, as well as in the life extension of existing power stations. This was a constant theme at several conferences associated with IIW Annual Assemblies during this period including the 65th Annual Assembly in Denver in 2012. The IIW publication *Guidance on Assessment for Fitness for Purpose of Welded Structures*, along with input from other welding research institutes within the broad umbrella of IIW, was to provide the degree of surety, through careful assessment, that the service life of such generating units could be extended well beyond their original design life. This was of tremendous economic importance since the vision for a transition from fossil fuel to renewable energy resources appears to be optimistic at best – this shift 'will take strong political will and emotional fortitude and decades to accomplish'. [3]

*Interest in nuclear power capacity has increased significantly in recent times with over 60 reactors currently under construction in 15 countries*

For the near future, as a result, with developing countries wanting to use fossil fuels to service their growing populations, this situation is not expected to lessen greatly. The welding industry, in consideration of this, has therefore played a prominent role in the application and development of new state-of-the-art processes and procedures in the construction, inspection and repair of coal-fired and nuclear power generation plants. This issue has achieved greater relevance through the growing synergy and participation between Working Units in IIW to demonstrate the importance of structural health monitoring (SHM) through a workshop held at the 68th Annual Assembly and Conference held in Helsinki in 2015. Over 60 delegates from 17 countries attended the workshop that covered the extension of the life of ageing structural assets beyond normal economic restraints through the use of the latest techniques, such as sensors, to manage degradation and provide a high level of confidence in the integrity of such assets.

Power from fossil fuel plant is now diminishing rapidly and, despite initial setbacks caused by the Fukushima tsunami in 2011, the interest in nuclear power capacity as an alternative has increased significantly in more recent times with over 60 reactors currently under construction in 15 countries, notably China, South Korea, the United Arab Emirates (UAE) and Russia.[4] China on the other hand has also signalled a significant change from fossil fuel dependency to renewable energy sources from 2015 on. China's influence as a major promoter of international infrastructure development in Africa and Central Asia therefore carries strong implications for other developing countries' energy and the choices that they will make.[5] It is simpler and more effective to use solar and wind power to individually service more isolated communities than to provide energy through an extensive supply and grid network, a situation which is now becoming more common in developed countries.

Wind power has now become the world's fastest growing energy source over the last decade and has also become one of its most rapidly expanding industries with sales of over USD 3 billion in 2008.[6] By 2012 it had become a USD 10 billion/year industry in the USA alone, with wind energy accounting for 40% of the increased electricity capacity for that year in the USA[7]. China has rapidly become a world leader in wind power and now ranks fourth in installed capacity.[8] In Europe, wind farms have also increased at an exponential rate with both Denmark and Portugal producing over 20% of their total electricity production through wind generated power. Conventional and advanced welding processes have been the key to the construction of wind turbines, in particular submerged arc welding and GMAW processes, employing, in some situations, robotic welding to reduce costs of manufacture and to increase productivity. This has made wind power more competitive as a source of energy.

From a research point of view, experimental work using multi-pass laser welding has been carried out at TWI in the UK to further the science of welding of thicker metal sections of wind towers, thereby extending the scope in the manufacture of larger and stronger wind turbines. Research on a national basis has been carried out by several members of IIW to improve productivity and increase the uptake of wind farms as an economic alternative to conventional means of producing electrical power. The depth of knowledge provided through the work of the many Working Units within the Institute has been of great importance including, of course, the members of Commission XV *Design, Analysis and Fabrication of Welded Structures* (C-XV) which comprises experts from several disciplines all critical to the welding of buildings, bridges and offshore structures.

The work of many of the IIW Working Units has consequently been paramount in the diffusion of technology to the engineers, designers and constructors of wind farms that have increasingly become more vital to the environmental future of this planet. For instance, the Wikinger offshore wind farm in the Baltic Sea, off Germany, will produce 350 MW of electricity, enough to supply 350 000 German households and save 500 000 tonnes of $CO_2$ per year.[9] The contribution of national welding organisations, which are members of IIW, are critical to the success of such enterprises.

*Volker Schöppner*

DVS, as well as associated German research organisations such as the Fraunhofer Institute, are integral to the continuing progress and efficiency of wind turbines through targeted research into the design, materials, welding and processes used in the manufacture of wind farm rotor blades, including hybrid materials and rotor blade coatings. More recently, polymer joining and adhesive technology with modern hybrid materials and fibre reinforced plastics have increased in importance and Commission XVI *Polymer Joining and Adhesive Technology* (C-XVI), chaired by Prof. Dr-Ing. Volker Schöppner (Germany) is ideally positioned to provide guidance through a forum of the world's leading scientists involved in these relatively new spheres of materials joining, as well as to fields other than wind turbines, such as the aviation industry.

'Buildings, too', it was said, 'are children of the Earth and the Sun'.[10] These words were used by Frank Lloyd Wright, the great American architect, promoting unity of purpose in the planning of buildings to blend naturally into the environment. The Chrysler Building in New York, USA is an example of this and, at 319 metres tall, still remains supreme as one of the most beautiful buildings ever built. The Chrysler Building, one must be reminded, was riveted, not welded. It was constructed from masonry with a steel frame and metal cladding, reputedly using 391 881 rivets to hold the steel frame together.[11]

At the beginning of the 1990s the tallest building in the world was the Sears Tower (now known as the Willis Tower) in Chicago, USA which, incidentally, utilised an estimated 73 000 tonnes of steel in its construction and over 40 000 electro-slag welds for the high-strength columns to support its immense weight.[12] The Petronas Twin Towers in Kuala Lumpur, Malaysia surpassed the Willis Tower in 2008 with a height of 452 metres. This resulted in almost unlimited construction of higher and higher buildings across the globe, with USA (One World Trade Center – 546 m), Saudi Arabia (Makkah Royal Clock Tower – 601 m), China (Shanghai Tower – 632 m), Japan (Tokyo Skytree – 634 m) and UAE (Burj Khalifa – 830 m) following each other in quick succession. The proposed tallest building of all, the Kingdom Tower in Jeddah, Saudi Arabia (1 000 m), is scheduled to be completed in 2019 at an estimated cost of USD 1.3 billion. No construction process other than welding would have made these feats possible.

*Chrysler Building is still one of the most beautiful buildings in the world*

China, with five of the 10 tallest buildings in the world, undisputedly, has now taken over the mantle from the USA as the great constructer of high-rise buildings from 1990 to the present, each having their own uniqueness but requiring similar technical requirements in their construction. The Chinese Welding Association (CWA) was to play a key role in assisting the Chinese government in welding-related work such as this. Importantly, CWA was to understand the need for companies involved in building projects to be accredited to IIW's company certification scheme according to ISO 3834 to add surety and consistency in the welding methods involved in the construction of iconic buildings such as the Shanghai Tower which, when finished in 2011, stood supreme above all buildings around it.

*Construction of the 632 m high Shanghai Tower*

As a prelude to this immense phase of building structures, a need for the construction of transportation systems became more apparent for economic and commercial reasons in the supply of goods and services between nations. The globalisation of trade and industry over the last 25 years necessitated great investment in port facilities, particularly in South-East Asia, where Shanghai and Singapore were ranked in first and second positions among the leading ports in the world, based on cargo and container traffic.[13]

During this last decade, one of the corner stones of IIW's emphasis on quality management has been to identify and transfer global best practices in the field of quality management for welding and to successfully apply this to a wide range of infrastructure projects. This largely has been achieved through the resources of the Select Committee *Quality Management in Welding and Allied Processes* (SC-QUAL), which played a strategic role in the development and implementation of quality standards and guidelines for welding in the construction and fabrication industries, including the requirements for personnel and company certification. In this regard, the qualification of welders and welding procedures has proven to be one of the best means of ensuring quality requirements were met, not only in construction across ships and port facilities, but also in most infrastructure projects.

Both Det Norske Veritas and Lloyds Register of Shipping have also had a profound influence in maintaining quality in projects by ensuring that the highest levels of classification, certification and technical assurance are applied across wide sectors of the maritime, energy

*The latest change in the building of large ships has been a trend towards the construction of bigger container ships for world trade distribution*

and oil and gas industries. Coupled with the overriding interests of these two organisations, IIW's qualification of International Welding Engineers (IWE), Welding Specialists (IWS) and Welding Technologists (IWT), and International Welding Inspection Personnel (IWIP) accompanied by Welding Inspectors certified through IIW Member Societies, has become a necessary part of achieving the level of conformity in the construction, design, welding and repair of maritime shipping. Through the combined efforts of skilled personnel, such as these, it is possible to ensure that quality is built into the manufacture of a single project from the very beginning to avoid extensive rework during construction, or when the project has been completed.

In many instances the costs of repairs and disruption to production schedules can far outweigh the cost of doing things right in the first place – it is not possible to inspect quality into welded product after the project has been completed – at least not without great cost. Non-destructive testing (NDT), a focus of Commission V *Non-destructive Testing and Quality Assurance of Welded Products* (C-V), additionally, has been a major partner in ensuring that structural welding of critical plant and equipment is completed in accordance with specification, often through the use of conventional or more sophisticated NDT techniques in the detailed examination of critical welded joints to achieve compliance.

The megaships of today have been entirely dependent on innovation in construction techniques and advances in the productivity of welding and its processes. Commensurate with this, significant evolutionary change has taken place since 1990, notably in the marked decline in the construction of supertankers, with many of those built in the late 1970s, such as the *Seawise Giant* (564 650 Dead Weight Tonnage (DWT)) broken up in 2010 and used for scrap. This does not mean to say that supertankers have finally disappeared from the seas. Four more prominent Ultra Large Crude Carriers (ULCC), the TI Class supertankers, were built in Okpu, South Korea in 2002/3 but two of these were converted into sophisticated floating storage and offloading vessels after extensive alterations in 2009/10.[14] Mindful of the saying that a supertanker 'is an accident waiting to happen' the emphasis in modifying existing tankers, or building new tankers, since 2000, has been towards vessels with smaller DWTs of around 90 000 tons that can perform in challenging conditions, such as severe ice in the Arctic, a change that has increased safety due to double hull construction and thereby lessening the possibility of oil spills damage to the environment.[15]

The latest change in the building of large ships has therefore been a trend towards the construction of bigger container ships for world trade distribution. An indication of the extent of this, in recent years, was that almost 12 million tons of newly constructed container ships were delivered in 2009 with over 85% of this new capacity being built and welded in South Korea, China and Japan.[16] Many smaller container ships were also

converted to larger versions through modification. The building of container ships gave rise to a new definition for the size of the ship in terms of the number of containers they could hold, TEU, which stands for the size of the container (Twenty-foot Equivalent Unit). The largest container ships built up to 2015 were the four ships constructed on behalf of MSC (Switzerland) in South Korea with a maximum capacity of 192 224 TEU and a gross tonnage of 193 000 tons.

The other significant trend in the construction of ships has been manifested in the cruise ship industry that has seen a remarkable change in the size of luxury ships with gross tonnages of up to 227 000 tons being achieved.[17] This has created considerable employment for welding personnel in shipyards around the world, including the Meyer Werft GmbH shipyard on the River Ems, Germany and the STX shipyards in Turku, Finland and Saint-Nazaire, France. The latter produced the largest luxury ship to date, *Harmony of the Seas*, for the US shipbuilder Royal Caribbean International, when launched in 2016.

The pressing requirements of meeting time frames and sea trials have resulted in modern assembly techniques using precise modular construction and the latest welding techniques. Precise manufacturing, in this regard, requires production to very narrow tolerances to minimise assembly costs and to achieve exact fit between individual modules for pre-positioning. The use of laser cutting and welding has been indispensable in achieving greater accuracy, higher rates of production and savings by the use of this technology.[18] Additionally, robotic welding and cutting has become increasingly significant in lowering labour costs and increasing productivity in the shipbuilding industry and would be expected to be more so in coming years.

*The size of luxury ships being constructed is ever increasing*

Globalisation in all its aspects has therefore produced many changes to the shipping industry and also for free-standing maritime structures such as oil rigs. The relatively small size of many gas fields and the remote location of some make them uneconomic for development by conventional onshore liquefied natural gas (LNG) processing plant using subsea pipelines. This has given rise to the development of revolutionary technology by Shell to construct the world's biggest Floating LNG (FLNG) production facility which has the potential to transform the way natural gas resources are developed without the need to lay pipelines or build processing plants on land.

The FLNG plant, which will produce, liquefy, store and transfer chilled, compressed LNG directly into ocean-going vessels, will weigh approximately six times as much as the largest aircraft carrier, some 260 000 tonnes of which will consist of steel, and will measure 488 metres by 74 metres, roughly the size of four soccer fields. When completed the FLNG vessel will be installed to develop the Prelude and Concerto gas fields in the Browse Basin, 200 km offshore from the coast of Western Australia. The FLNG project is global in nature with the hull and topside modules being built in South Korea; the turret fabricated in Dubai; the subsea structure in Malaysia; control systems in Singapore and all components coming together at Geoje, South Korea, one of the world's largest shipyards.[19] Safety and quality of welding at all stages of production were lead drivers in the construction of the floating platform.

*Shell's Prelude floating liquid nitrogen gas facility*

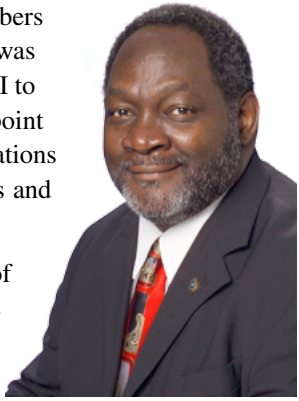
Aviation and airport facilities also occupy a significant role in globalisation overall and play a key part of a nation's economic activities through encouraging international business, commerce and tourism. The vital measurement of the economic benefits from air travel is that aviation transports close to two billion passengers annually and 40% of interregional exports of goods (by value), generating 29 million jobs worldwide.[20] With respect to airport construction, it was estimated that over USD 385 billion of projects were under construction in 2013/14 with China leading the way with 59 regional airports to be completed by 2015.[21] Nevertheless, it is important to reiterate that welding was of fundamental importance in the construction of modern airport infrastructure and in the modes of transport used by these facilities.

The Airbus A380, first introduced into service in October 2007, is typical of the new generation of wide-bodied commercial aircraft that has used the latest materials and joining technologies in their construction, including composite materials that comprised 20% of the airframe, and carbon-fibre and glass-fibre reinforced plastics, which have been used extensively in the wings and fuselage.[22] In achieving the technical and commercial success of an aircraft such as this, advanced materials and welding techniques such as laser beam welding, friction stir welding and adhesive bonding were to play a critical role in reducing the Airbus A380s structural weight by as much as 25%, producing an aircraft that unquestionably was much more efficient all around.[23] The Boeing Dreamliner 787, smaller in size than the A380, was the first commercial aircraft to have a composite fuselage, wings and other structural components of the aircraft thereby achieving considerable savings in the structural weight as a result of the latest advanced joining techniques for these materials.

China has also contributed significantly to advances in the welding and joining of aerospace materials through the facilities of the Beijing Aeronautical Manufacturing Technology Research Institute (BAMTRI) and its Deputy Director of Science and Technology, Prof. Dr Guan Qiao. Qiao was responsible for the development and success of many innovations in joining materials including low stress, non-distortion TIG welding of thin walled structural elements used in aerospace applications. IIW, in many ways, was to contribute to the work undertaken by Qiao and his colleagues through the collegial relationship with many experts within IIW's Commissions, including Mr Ernest Levert (USA) who assisted and provided expert opinion on the latest developments in

*Guan Qiao*

welding technology. In developing relationships with IIW members even further, the application of friction stir welding in China was strengthened through an agreement between BAMTRI and TWI to establish a Friction Stir Welding Centre in 2002.[24] From that point on China was to utilise friction stir welding in aerospace applications including the manufacture of airline storage panel components and carrier rocket storage tanks.



*Ernest Levert*

In the main, fundamental research into the welding of new materials and joining of composites for the aerospace industry is undertaken by specialist research organisations throughout the world such as TWI and BAMTRI, many of which are directly or indirectly associated with IIW Working Units. Appropriately, global industry demands and new developments in the aviation industry have necessitated re-activation of the previous Select Committee *Air* (SC-AIR), to cover permanent joints in new materials and coatings for aircraft engineering under the chairmanship of Prof. Shuili Gong (China).

The work of this committee covers the latest joining technologies for new aircraft and the research needs of the aviation and aerospace industries where IIW's expertise and international networking capabilities can effectively be utilised, in particular in the areas of solid state welding, power beam processes, behaviour of materials, new welding filler metals for aircraft structures and engine components, and the use of advanced NDT of aircraft joints and adhesive-based repair joints. Again it will be the use of innovative welding processes such as electron beam and laser beam welding and other developments that will lead the way in the quest for man to explore the outer regions of space and the universe.

Critical infrastructure is also inclusive of road and rail transport, so important in the transfer of materials, goods, other resources and people within a country, or between countries. This includes construction and maintenance of roads, building of bridges, viaducts, canals and other crucial structures to overcome natural geographical barriers. With respect to improvements to road transport, including heavy vehicles, one of IIW's Select Committees on *Automotive and Road Transport* (SC-AUTO), has played a strategic role in leading discussions on the application of new technologies and materials concerning joining in the automotive industry in order to improve vehicle safety while, at the same time, decreasing vehicle

*Michael Rethmeier*

*Millau Viaduct, France*

*Japanese magnetic levitation train*

assembly costs and the negative effects of the automotive industry on the environment.[25] Led by Prof. Dr-Ing. Michael Rethmeier (Germany), this particular committee has developed a strong international network of experts from leading global automotive companies, suppliers and major international universities/research institutes to provide an international forum for discussion and dissemination of latest technical information on welding in the automotive industry. In doing so this Select Committee actively encourages the development of new transfer mechanisms and tools for technology in the industry that exemplifies IIW's approach in engaging with other organisations in the world to bring the beneficial changes in technology to all those that live in it.

It goes without saying that other IIW Commissions and Working Units also contribute significantly to other developments on land, with bridges having a certain amount of distinction since they are an essential link in the transportation system. The past 25 years have seen remarkable transformations in the design and construction of rail and road bridges that have resulted in some unique and outstanding structures. Perhaps among the very best is the Millau Viaduct over the River Tarn in southern France. Constructed to avoid severe traffic congestion en route from Paris to Spain in 2004, it became the tallest bridge in the world at that time when measured to the top of its highest mast (343 metres) to the valley floor.[26] Of cable-stay design and supporting a welded steel deck of box-girder design the bridge was completed in three years at a cost of EUR 394 million.

When it was opened it was the longest suspended bridge in the world, designed by the renowned British architect, Norman Foster and the French structural engineer, Michel Virlogeux. It was considered to be one of the greatest achievements in engineering and on par with Frank Lloyd Wright's Chrysler Building in New York in terms of its artistic value. Construction of bridges also played an important part in other forms of land transport and

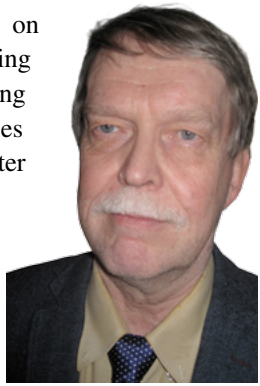
the Danjang Kunshan Grand Bridge in China, opened in 2011, occupied a distance of 164.8 kilometres of road and rail including the Beijing-Shanghai high-speed rail line, officially being the longest bridge in the world. It is important to note that its construction consisted of around 450 000 tons of steel in its welded structure and without the facility to produce continuous welded track, high-speed rail travel would not have advanced to the stage as we know it today.

Magnetic levitation as a technology has the means to take speeds of high-speed trains to well above the current levels of 300 km/hr, perhaps approaching 600-700 km/hr. Recently, a trial Japanese seven-car magnetic levitation train set the world record for a high-speed train with a speed of 600 km/hr in a short test run.[27] There is expectation that the rail journey from Tokyo to Nagoya (286 km) will take only 45 minutes at a speed of 500 km/hr with the commercial introduction of a Maglev train in 2027. Japan is hoping to sell its high-speed rail technology overseas as part of an attempt to revive the world's third biggest economy through infrastructure exports.[28] For this, eventually, to happen the supporting structure and guide ways will require state-of-the-art welding technology to ensure the integrity and safety of high-speed trains using magnetic levitation principles are maintained.

The heart of all progress is not just the major structures that stand out for all to see. It is the smaller, less visible world of nano- and micro-technology that ensures that the larger world can operate and fulfil its operational function. A failure of a small switch or circuit board can completely disrupt a whole railway system or power supply and cause significant economic loss and inconvenience. Welcome to the world of microjoining! The involvement of microjoining in the electronics, instrument, and actuator and sensor industries is as important and as extensive as that of welding in other manufacturing industries.[29] The proper functioning of small mechanical devices and electronic systems in the aerospace, medical, telecommunications, computer, automotive and oil and gas industries is critically dependent on the use of efficient and reliable microjoining techniques.

The welding industry has responded to these challenges and IIW has remained actively involved in these activities through participation in Commission VII *Microjoining and Nanojoining* (C-VII) and the preceding Select Committees headed by Prof. Norman Zhou (Canada), a group with the goal to identify, develop and create best practices in microjoining and nanojoining techniques. Miniaturisation of medical devices and the use of implantable prosthetic materials in the human body have also increased markedly in recent years meaning that welding in such situations has had to keep up with human expectations. This has required special joining techniques such as ultrasonic and thermosonic welding

for electronic device interconnections, laser metal deposition on orthopaedic joint implants and implant coatings to facilitate bonding to the bone.[30] This is an area where medical welding science is moving rapidly and new welding and joining techniques and processes are being developed almost on a monthly basis to provide greater assurance in the use of medical devices and implants.



*Veli Kujanpää*

Additive manufacturing is a recent process using 3-D data to build up a component in layers by depositing material, instead of manufacturing a component from solid material by machining or other methods. This process captured the imagination of attendees at a joint seminar involving Commissions I, IV, XII and SG-212 in July 2016. Personnel from many welding and research organisations met to discuss the inherent cost savings in producing difficult-to-manufacture components in areas where conventional manufacturing had reached its limitations. It has particular application for e-manufacturing in the series production of miniaturised parts, including those for medical devices, and a wider application in the aerospace industry. This process serves as a perfect example of the need for IIW to be engaged in the emergence of innovative processes which inevitably will involve the welding industry to a much greater extent over the next decade.

The emphasis on the importance of additive manufacturing in recent years has resulted in Commission I, now renamed, *Additive Manufacturing, Surfacing and Thermal Cutting* (C-I), taking on the overall responsibility for this activity under the chairmanship of Prof. Veli Kujanpää (Finland). C-I has the specific aim of a better scientific understanding of these processes and their practical application through close cooperation with other Working Units such as Commissions IV, XII and SG-212.[31]

The growing synergy between Working Units on the importance of additive manufacturing culminated in a special workshop at the 68th Annual Assembly in Helsinki in 2015. The workshop reflected the rapidly expanding global move to this technology and explored the latest developments in modelling and optimisation of dimensional accuracy as well as material innovations and their applications in industry. Organised by the four Working Units mentioned previously, the workshop attracted 149 people from 31 different countries. In view of the continuing interest in additive manufacturing, the first ever IIW International Congress on Welding, Additive Manufacturing and Associated Non-Destructive Testing (ICWAM 17) has been organised by the Institut de Soudure in Metz in May 2017 in order to promote an active dialogue between academic researchers and industry, thereby ensuring and maintaining IIW's interests in the furtherance of new techniques and processes.[32]

Without losing sight of the substantial changes that lie ahead, the period from 1990 to 2015 has encompassed some of the greatest technological advances and challenges

experienced by the human race. At the forefront of these changes have been continued advances in new materials and the means by which these materials can be joined. Key components in meeting the challenges of the welding industry for the application of the latest in welding science and technology, therefore, are the availability of qualified and trained human resources and the need for collaborative research among various disciplines in basic and applied welding science. IIW fulfils this role extremely well through its qualification and certification schemes and also through the innovative resources available through its Commissions, Select Committees and Study Groups.

As Mr Robert Salkin, IIW President 1987-1990 was to say in 1988, after IIW's first 40 years of existence, 'Whatever the truth, the IIW was endowed with a structure that was necessary and sufficient to accommodate these evolutions and allow itself, 40 years on, to tackle with confidence the great challenges of the end of this century'.[33]

The challenges have certainly become more complex since Salkin uttered these words but the inherited strength of IIW's collaborative approach lives on. In the future, IIW will need to be continually responsive and innovative in meeting the immensely different challenges of the twenty-first century as it strives to remain relevant as the leading organisation in the world for the science of welding and joining.

## ENDNOTES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# appendix 1

## IIW Milestones 1990-2015

Highlighting in chronological order significant events and achievements in the history of IIW within this time period, including the terms of office of IIW Presidents and appointments within the IIW Secretariats.

### 1990

Incoming IIW President, Dr Norman Eaton (Canada), gave inaugural speech *Vision for 2000*.

First ISO standard published by IIW as an ISO international standardising body.

Mr Philip Boyd retired as IIW Secretary General after 22 years of service and replaced by Mr John Hicks.

First industrial exhibition held at an IIW Annual Assembly, Montreal, Canada.

Introduction of computerised database as the first step towards electronic document management.

### 1991

Vienna Agreement signed and a meeting held between ISO, CEN and IIW to set up a tripartite agreement.

Cooperation agreement signed with Woodhead Publishing for re-design and e-publishing of IIW books.

### 1992

First meeting of the IIW Asia-Pacific Region held in Darwin, Australia.

Final report of the IIW Working Group (WG) *Strategic Planning* presented by Dr Guilio Costa (Italy) at the IIW Annual Assembly in Madrid.

The IIW Granjon Prize (3 categories A, B and C) awarded for the first time to Mr Alfredsson (Sweden), Mr Wangen Lin (USA) and Dr Xian (China).

IIW Commission XIV formed WG 13 to progress the implementation of an IIW global harmonised education, training, qualification and certification scheme.

## 1993

Mr Raül Timerman elected as IIW President, first from the southern Hemisphere.

*Joining Nations – A history of the International Institute of Welding 1947-1990* by Philip Boyd published by Woodhead Publishing.

Proposal for restructuring IIW into a single Secretariat submitted to the IIW Executive Council.

IIW Yoshiaki Arata Award sponsored by the Japanese delegation and first awarded to Prof. Dr-Ing. I. Hrivnak from Slovakia.

## 1994

IIW Governing Council unanimously approved resolution to go ahead with an IIW global education, training, qualification and certification scheme at the Beijing IIW Annual Assembly.

New IIW Board of Directors WG *Regional Activities and Liaison with Developing Countries* (WG-RA) formed.

English adopted as the official language for IIW and for the publication of *Welding in the World*.

Principle of a single IIW Secretariat adopted

## 1995

Proposal to run the single IIW Secretariat by the Institut de Soudure accepted by the Governing Council.

Mr Michel Bramat appointed Executive Director of the IIW Secretariat.

IIW Commission VII *Authorisation and Qualification* formed to establish the guidelines for the education, training, qualification and certification scheme.

## 1996

Prof. Yuzuru Fujita (Japan) elected as IIW President, the first from the Asia-Pacific region.

New Constitution for IIW approved at the IIW Governing Council meeting at the IIW Annual Assembly in Budapest.

IIW Governing Council renamed as the IIW General Assembly and Executive Council renamed as the Board of Directors.

## 1997

Formal agreement reached between IIW and EWF to cooperate on the delivery of a unified scheme for IIW education, training, qualification and certification.

Formal strategic planning process for IIW adopted following a meeting in Abington (UK) in November.

## 1998

IIW International Authorisation Board (IAB) structure progressively developed and EWF/IIW agreement prepared.

Elsevier ceased publication of *Welding in the World* and IIW undertook self-publication as a result.

Value Added Tax becomes a central issue in the management of IIW's financial affairs.

Mr Marcel Evrard (France) becomes the first recipient of the inaugural IIW Thomas Medal, sponsored by the AWS.

## 1999

Former Treasurer of IIW, Mr Bevan Braithwaite (UK) started three-year term as IIW President.

IIW IAB formally established with Mrs Rute Ferraz as Chief Executive Officer.

New Business Plan developed focusing on the long-term core activities of IIW including regional activities and the environment.

The principle of cohabitation promoted by IIW then adopted by ISO for the drafting of international welding consumable standards, catering for both the European Market and Pacific Rim

IIW Select Committee (SC) *Environmen*t approved by the General Assembly.

IIW reached 40 member countries.

## 2000

Two new ISO/IIW standards published, both from IIW Commission II *Arc Welding*, including ISO 8249 *Welding -- Determination of Ferrite Number (FN) in austenitic and duplex ferritic-austenitic Cr-Ni stainless steel weld metals.*

IIW Secretariat contract with Institut de Soudure renewed.

China became the first country outside of Europe to have its IIW ANB approved.

Inaugural IIW Evgeny Paton Prize awarded to Dr Steve Maddox (UK).

## 2001

Mr Daniel Beaufils appointed IIW Secretariat CEO.

New IIW Constitution implemented including only one IIW General Assembly meeting instead of two.

Agreement reached for IIW Technical Reports and Specifications to be added to the options available to IIW to publish documents through ISO.

Introduction of the IIW Kenneth Easterling Award, first presented to V.A. Karkhin, A.S. Ilyin, V.V. Plochikhine, H.W. Bergmann for their paper *Inverse Modelling of Fusion Welding Process*.

## 2002

Mr Bertil Pekkari (Sweden) became President of IIW.

IIW Technical Committee became the IIW Technical Management Board (TMB).

IIW enters a new era in its activities with the development of IIW's website.

## 2003

Introduction of on-line version of *Welding in the World*.

First IIW WG-RA Technology Diffusion Workshop held at the 56th IIW Annual Assembly hosted by Romania.

## 2004

IIW WeldCare programme implemented throughout South-East European IIW Member Countries with further IIW Technology Diffusion Workshops.

National Welding Societies of Bulgaria, Romania and Serbia & Montenegro established the basis for a Network for Technology Transfer in Welding in the South-East European region (SEENet).

IIW International Congress in Cairo, Egypt, opened new contacts with the African region.

## 2005

IIW Statement on Manganese released by Board of Directors.

Mr Chris Smallbone (Australia) commenced term as President at the 58th IIW Annual Assembly in Prague.

Inaugural IIW Sossenheimer Award presented to Prof. Horst Cerjak (Austria).

IIW Board of Directors agreed to enter the field of certification.

Total of 32 countries attained IIW IAB ANB status: 25 European, 7 non-European, and 3 applicant countries.

First IIW International Congress held in India.

IIW WG *Publications* renamed WG *Communication*s (WG-COM), changed in 2006 to IIW Board of Directors WG *Communications and Marketing* (WG-COM&MARK)

## 2006

IIW Recognition Awards for contributions at IIW Annual Assemblies (10 years, 20 years and 30 years) issued for the first time.

First South-East European IIW International Congress held in Timişoara, Romania.

Memorandum of Understanding signed between IIW and WorldSkills International.

Introduction of a major IIW project entitled *To Improve the Global Quality of Life Through Optimum Use of Welding Technology.*

## 2007

Comprehensive five year IIW Business Plan 2007-2012 launched.

New logo adopted for IIW on the occasion of its 60th Anniversary.

IIW SC *Standardisation* became the IIW Board of Directors WG *Standardisation*

IIW Commission VIII *Health, Safety and Environment* formed through the amalgamation of IIW Commission VIII *Health and Safety* and the SC *Environment*

## 2008

Prof. Dr-Ing.Ulrich Dilthey (Germany) commenced term as President of IIW.

IIW Task Group *Governance* launched.

Creation of IIW Commission XVII *Brazing, Soldering and Diffusion Bonding*

Retirement of Mr Daniel Beaufils as IIW Secretariat CEO and appointment of Mr André Charbonnier.

## 2009

Licensing agreement signed between IIW and EWF.

Contractual Joint Secretariat agreement signed between IIW, ISQ and EWF.

Appointment of a new IIW Secretariat CEO, Dr Cécile Mayer after Charbonnier moved to a senior position in the Institut de Soudure.

## 2010

*Welding in the World* achieved Science Citation Index (SCI) recognition retrospective to 2009.

IIW SC *Research and Development in Micro- and Nano-Joining Technology* established.

New services provided to the membership through IIW's website.

## 2011

Dr Baldev Raj (India) became President of IIW at the 64th IIW Annual Assembly in Chennai, India.

Total number of diplomas issued annually by IIW IAB passed 10,000.

First IIW European-South American School of Welding and Correlated Processes held in Brazil.

IIW Service Recognition Awards introduced by IIW TMB in appreciation of longstanding voluntary service by IIW Working Unit Chairs.

## 2012

Partnership created with Springer-Verlag to publish *Welding in the World*.

New IIW *Welding in the World* Editorial Board and Panel established with revitalised peer review procedures.

IIW White Paper (WhiP) *Improving the Global Quality of Life Through Optimum Use and Innovation of Welding and Joining Technologies* published.

Inaugural IIW *Welding in the World* Best Paper Award presented to Dr Thomas Bruder (Germany) and the co-authors of the paper *Interpretation of Overload Effects under Spectrum Loading of Welded High-Strength Steel Joints*.

Combined total of more than 90 000 IIW diplomas issued around the world since the education, training, qualification and certification scheme started.

## 2013

*Welding in the World* celebrated its 50th Anniversary as a leading technical publication.

New IIW project to build *National Welding Capability* introduced as part of the IIW WeldCare Programme.

Project to introduce 100 000 pages scanned from historical IIW technical documents into the IIW database commenced.

Inaugural IIW Halil Kaya Gedik Award sponsored by the Turkish delegation awarded to Mr Hideyuki Yamamoto (Japan).

## 2014

Prof. Gary B. Marquis (Finland) became President of IIW.

IIW Regional Activities Award, inaugurated in recognition of Mr Chris Smallbone and sponsored by the Australian delegation, presented to Prof. Dr-Ing. Dorin Dehealean (Romania).

The first Fellow of IIW awards presented to Prof. Dr-Ing. Cetin Morris Sonsino (Germany), Prof. Chitoshi Miki (Japan), Dr Thomas Siewert (USA), Prof. Dr Takashi Miyata (Japan) and Prof. Pingsha Dong (USA)

Open submissions to *Welding in the World* introduced.

IIW Research and Collaboration Colloquium presented by the IIW Study Group *Research* in Wollongong, Australia.

## 2015

First IIW Young Professionals meeting held at Helsinki Annual Assembly.

IIW IAB consisted of 46 countries of which 45 had active ANBs.

Approximately 125 000 international diplomas awarded through the IIW IAB since 2000.

26 active IIW ANBCCs had certified almost 1 700 companies worldwide, including 278 new companies in 2015.

# appendix 2

## IIW TASK GROUP HISTORY AND REVIEWERS

The researching, writing, editing and publication of this history of IIW from 1990 to 2015 has been managed by an IIW Board of Directors Task Group. The group has also been supported by a number of reviewers with extensive experience in IIW with the goal of achieving the greatest possible accuracy and coverage in this book. IIW would like to thank all these people for their contributions and support.

### Task Group History members

Mr Chris Smallbone – Chair
Mr David Barnett – Author
Ms Anne Rorke – Editor
Dr Cécile Mayer – IIW CEO
Ms Noëlle Fauriol – IIW Secretariat
Prof. Dr-Ing. Gary B. Marquis – IIW President
Dr Damian Kotecki
Dr Glenn Ziegenfuss
Ms Mireille Aubert – IIW Secretariat

### Reviewers

Mr Ang Chee Pheng (Singapore)
Prof. Bruno de Meester (Belgium)
Dr Norman Eaton (Canada)
Dr Damien Kotecki (USA)
Mr Mathias Lundin (Sweden)
Dr Martin Prager (USA)
Prof. Dr-Ing. Detlef von Hofe (Germany)
Prof. Norman Zhou (Canada)
Dr Luca Costa (Italy)
Prof. Dr-Ing. Dorin Dehelean (Romania)
Ms Noëlle Fauriol
Mr Ernest Levert (USA)
Dr Cécile Mayer
Prof. Dr-Ing. Luisa Quintino (Portugal)
Dr Glenn Ziegenfuss (USA)
Dr Wolfgang Zschiesche (Germany)

# appendix 3

## IIW BOARD OF DIRECTORS 2015

The truly international representation and positive impact of IIW is illustrated by the countries of origin and stature of the members of the 2015 IIW Board of Directors.

Pictured in the 2015 IIW Annual Report (https://cld.bz/sIfudRu) on pages 4-5.

Prof. Gary B. Marquis, IIW President, FINLAND

Mr Ang Chee Pheng, Vice-President, SINGAPORE

Mrs Hülya Gedik-Sadiklar, Vice-President, TURKEY

Mr Douglas R. Luciani, Treasurer, CANADA

Dr Baldev Raj, Immediate Past President, INDIA

Prof. Thomas Böllinghaus, Director, GERMANY

Mr Sorin Keller, Director, SWITZERLAND

Mr Jouko Lassila, Director, FINLAND

Mr Ernest D. Levert, Director, UNITED STATES OF AMERICA

Prof. Fumiyoshi Minami, Director, JAPAN

Prof. Américo Scotti, Director, BRAZIL

Mr Chris Smallbone, Director, AUSTRALIA

Prof. Wu Yixiong, Director, PEOPLES REPUBLIC OF CHINA

Mr James Guild, IIW IAB Chair, SOUTH AFRICA

Dr Luca Costa, IIW TMB Chair, ITALY

Dr Cécile Mayer, IIW CEO, FRANCE

*Note: Prior to 1997 the IIW Board of Directors was known as the IIW Executive Council.*

# appendix 4

## IIW MEMBER COUNTRIES 2015

The table below is based on information in the IIW 2015 Annual Report. It shows the IIW Member Country in column 1, then in column 2 the country's status as an IIW member, Authorised National Body (ANB) and ANB for Company Certification (ANBCC).

Column 3 gives the name of the Responsible Member Society and then other member organisation names where applicable, with a slash indicating a name in a different language. The names of ANB and ANBCC organisations in that country are given after the dash if they differ from the Member Society name, or if only one of the group of members in that country provides that service.

*Note: Each IIW Member Country is eligible to vote at the IIW General Assembly, known prior to 1997 as the IIW Governing Council.*

| | | |
|---|---|---|
| Algeria | Member | Research Center in Industrial Technologies (CRTI) |
| Angola | Member | Association for the Development of Welding in Angola (ADSA) |
| Australia | Member-ANB/ANBCC | Welding Technology Institute of Australia (WTIA) |
| Austria | Member-ANB /ANBCC | Schweisstechnische Zentralanstalt (SZA) |
| Belgium | Member-ANB | Institut Belge de la Soudure/Belgisch Instituut voor Lastechniek (IBS/BIL) |
| Brazil | Member-ANB | Associação Brasileira de Soldagem (ABS) |
| Bulgaria | Member-ANB | Bulgarian Welding Society – Bulgarian Center for Qualification in Welding (BCQW) |
| Cameroon | Member | Cameroon Welding Association |
| Canada | Member-ANB /ANBCC | Canadian Council of the IIW – Canadian Welding Bureau (CWB) |
| Croatia | Member-ANB/ANBCC | Croatian Welding Society (CWS) |
| Cyprus | Member | Cyprus Welding Institute |

| | | |
|---|---|---|
| Czech Republic | Member-ANB /ANBCC | Czech Welding Society |
| Denmark | Member-ANB | Danish Welding Society – FORCE Certification A/S |
| Egypt | Member | Central Metallurgical Research & Development Institute (CMRDI) |
| Finland | Member-ANB | Suomen Hitsausteknillinen Yhdistys (SHY)/ The Welding Society of Finland (WSF) |
| France | Member-ANB /ANBCC | Institut de Soudure (IS) – Association Française du Soudage (AFS) |
| Germany | Member-ANB/ANBCC | Deutscher Verband für Schweissen und verwandte Verfahren (DVS) – DVS Zert e.V. |
| Greece | Member-ANB | Welding Greek Institute (WGI) |
| Hungary | Member-ANB/ANBCC | Magyar Hegesztési Egyesület (MAHEG)/ Hungarian Welding Association (HWA) – Magyar Hegesztéstechnikai és anyagvizsgálati Egyesülés (MhtE) |
| India | Member-ANB /ANBCC | The Indian Institute of Welding |
| Indonesia | Member-ANB | Indonesian Welding Society (IWS) – Indonesian Welding Society ANB Committee |
| Iran | Member-ANB /ANBCC | Iranian Welding Research & Engineering Center (IWREC) |
| Israel | Member | The Israeli National Welding Committee (INWC) |
| Italy | Member-ANB /ANBCC | Istituto Italiano della Saldatura (IIS) – IIS CERT Srl |
| Japan | Members-ANB | Japan Institute of Welding (JIW) and Japan Welding Engineering Society (JWES) – JWES |
| Libya | Member | Advanced Occupational Center for Welding Technologies |
| Lithuania | Member | Lithuanian Welders Association |
| Malaysia | Member | Welding Institute (MALAYSIA) Bhd |
| Mexico | Member | Corporación Mejicana de Investigación en Materiales (COMIMSA) |
| Morocco | Member | Association Marocaine du Soudage et des Appareils à Pression (AMS-AP) |

| | | |
|---|---|---|
| New Zealand | Member-ANB /ANBCC | Heavy Engineering Research Association (HERA) |
| Nigeria | Member-ANB | Nigerian Institute of Welding |
| Norway | Member-ANB | Norwegian Welding Association/ Norsk Sveiseteknisk Forbund (NSF) |
| Pakistan | Member | The Pakistan Welding Institute |
| P.R. of China | Member-ANB /ANBCC | Chinese Welding Society – Chinese Welding Training & Qualification Committee (CANB/CANBCC) |
| Perú | Member | Pontificia Universidad Católica del Perú |
| Poland | Member-ANB /ANBCC | Instytut Spawalnictwa |
| Portugal | Member-ANB | Instituto de Soldadura e Qualidade (ISQ) |
| Republic of Kazakhstan | Member-ANB /ANBCC | Karaganda State Technical University – Kazakhstan Welding Association (KAZWELD) |
| Republic of Korea | Member-ANB | The Korean Welding and Joining Society (KWJS) |
| Republic of Macedonia | Member | Association for the Development and Advancement of Welding |
| Romania | Members-ANB/ANBCC | ISIM and ASR-Romanian Welding Society – ASR CertPers/ISIM Cert |
| Russian Federation | Members-ANB /ANBCC | Russian Welding Society and National Agency for the Control of Welding – Research Training Centre 'Testing and Diagnostics' (RTC)/ Prometey-Cert (CJSC) |
| Serbia | Member-ANB/ANBCC | Zavod Za Zavarivanje a.d. – DUZS Cert Pers/ ZAVOD-CERT |
| Singapore | Member-ANB | Singapore Welding Society (SWS) |
| Slovakia | Member-ANB/ANBCC | Vyskumny Ustav Zvaracsky (VUZ) – VUZ PI SR/CERTIWELD VUZ-PI |
| Slovenia | Member-ANB /ANBCC | Slovensko Drustvo Za Varilno Tehniko (SVDT) |
| South Africa | Member-ANB /ANBCC | Southern African Institute of Welding |
| Spain | Member-ANB /ANBCC | Asociación Española de Soldadura y Tecnologías de Unión (CESOL) |
| Sweden | Member-ANB | Svetskommissionen/Swedish Welding Commission (SWC) |

| | | |
|---|---|---|
| Switzerland | Member-ANB | Schweizerischer Verein für Schweisstechnik (SVS)/<br>Association Suisse pour la Technique du Soudage |
| Thailand | Member-ANB | Welding Institute of Thailand (WIT) |
| The Netherlands | Member-ANB /ANBCC | Nederlands Institut Voor Lastechniek (NIL) |
| Tunisia | Member | Centre Technique des Industries Mécaniques et Electriques (CETIME) |
| Turkey | Member-ANB /ANBCC | Gedik Education and Social Benefits Foundation (GEV) and<br>Turkish Welding Technologies Academy (TKTA) – GEV |
| Ukraine | Member-ANB/ANBCC | E.O. Paton Electric Welding Institute –<br>The Paton Welding Institute Training and Qualification Center/Paton Cert |
| United Kingdom | Member-ANB /ANBCC | UK Section of the IIW – TWI Certification Ltd |
| United States of America | Members-ANBCC | American Welding Society (AWS), Edison Welding Institute (EWI) and Welding Research Council (WRC) – United States of America Authorised National Body for Company Certification (USA ANBCC) |
| Vietnam | Member | Vietnam-German Technology Transfer and Training Center (HWC) |

*ANB:* Authorised National Body
*ANBCC:* Authorised National Body for Company Certification

# appendix 5

## IIW PRESIDENTS AND SECRETARIATS

Over the years since its formation in 1948, membership of IIW has spread around the globe as demonstrated by the countries of origin of its Presidents, representing nations in all regions of the world.

Until 1995, IIW's operation was supported by two Secretariats provided by Member Societies – a General Secretariat in the UK provided by TWI and a Scientific and Technical Secretariat in France provided by the Institut de Soudure. After that time, a single Secretariat was provided in France.

| PRESIDENT | TERM | COUNTRY |
|---|---|---|
| G. B. Marquis | 2014-2017 | FINLAND |
| B. Raj | 2011-2014 | INDIA |
| U. Dilthey | 2008-2011 | GERMANY |
| C. Smallbone | 2005-2008 | AUSTRALIA |
| B. Pekkari | 2002-2005 | SWEDEN |
| B. Braithwaite | 1999-2002 | UK |
| Y. Fujita | 1996-1999 | JAPAN |
| R. Timerman | 1993-1996 | ARGENTINA |
| N. F. Eaton | 1990-1993 | CANADA |
| R. V. Salkin | 1987-1990 | BELGIUM |
| F. Wallner | 1984-1987 | AUSTRIA |
| J. F. Skriniar | 1981-1984 | CZECHOSLOVAKIA |
| U. Girardi | 1978-1981 | ITALY |
| B. Jakobsson | 1975-1978 | SWEDEN |
| H. G. Geerlings | 1972-1975 | NETHERLANDS |
| W. Soete | 1969-1972 | BELGIUM |
| F. L. Plummer | 1966-1969 | USA |

| PRESIDENT | TERM | COUNTRY |
|---|---|---|
| K. Rühl | 1963-1966 | GERMANY |
| W. Edström | 1960-1963 | SWEDEN |
| U. Guerrera | 1957-1960 | ITALY |
| H. Biers | 1954-1957 | USA |
| H. E. Jaeger | 1951-1954 | NETHERLANDS |
| P. Goldschmidt-Clermont | 1948-1951 | BELGIUM |

## IIW Secretariat Heads

| NAME | TERM | TITLE |
|---|---|---|
| C. Mayer | 2009-Present | Chief Executive Officer IIW Secretariat |
| A. Charbonnier | 2008-2009 | Chief Executive Officer IIW Secretariat |
| D. Beaufils | 2001-2008 | Chief Executive Officer IIW Secretariat |
| R. Ferraz | 1999-Present | Chief Executive Officer IIW IAB Secretariat |
| M. Bramat | 1995-2001 | Executive Director IIW Secretariat |
| J. Hicks | 1990-1995 | IIW Secretary General |
| M. Bramat | 1990-1995 | IIW Scientific and Technical Secretary |

# appendix 6

## IIW WORKING UNITS 1990-2015

Current IIW technical and administrative Working Units (WU) are listed below, showing the acronym for the unit which may have been used in the text of this book. The term 'present' denotes that the position of Chair was held at the end of 2015. Page numbers for references to Working Units and Chairs in the text can be found using the index.

To help clarify the history of the units, the name of the WU in 1990 is listed first, and any name changes after 1990 or re-allocation of a Commission number are shown. Early history may be found in the book 'The Birth of IIW, Joining Nations – The History of the International Institute of Welding 1947-1990' by Philip Boyd.

Working Unit Chairs are pictured in the 2015 IIW Annual Report (https://cld.bz/sIfudRu) pages 14-25. Further details of each Working Unit and its members are available on the IIW website www.iiwelding.org. This includes details of the large number of IIW technical sub-commissions and joint working groups which work in a very wide range of welding and related subject areas.

## TECHNICAL MANAGEMENT BOARD

| WU | Title / History | Chairs | Dates |
|---|---|---|---|
| TMB | Technical Committee<br>2002: Technical Management Board | R.W. Nichols (UK) | 1990-1996 |
| | | D.R. Reynolds (Canada) | 1996-1999 |
| | | R. Dolby (UK) | 1999-2002 |
| | | U. Dilthey (Germany) | 2002-2005 |
| | | B. de Meester (Belgium) | 2005-2008 |
| | | C. Wiesner (UK) | 2008-2011 |
| | | G. Marquis (Finland) | 2011-2014 |
| | | L. Costa (Italy) | 2014-Present |
| WiW-EdBoard | 2010: Editorial Board for *Welding in the World* | B. de Meester (Belgium) | 2010-2012 |
| | | J. Lippold (USA) | 2012-Present |

## Commissions

| WU | Title / History | Chairs | Dates |
|---|---|---|---|
| C-I | Brazing, Soldering, Thermal Cutting and Flame Processes<br>2008: split into<br>• C-I: Thermal Cutting and Allied Processes<br>• New C-XVII: Brazing, Diffusion Bonding and Soldering<br>2015: Additive Manufacturing, Surfacing and Thermal Cutting | C. Messager (France) | 1988-1994 |
| | | G. Engblom (Sweden) | 1994-2001 |
| | | L. Heikinheimo (Finland) | 2001-2008 |
| | | V. Kujanpää (Finland) | 2008-Present |
| C-II | Arc Welding<br>2001: Arc Welding and Filler Metals | F.R. Coe (UK) | 1977-1991 |
| | | D. Kotecki (USA) | 1991-2003 |
| | | V. van der Mee (The Netherlands) | 2003-2012 |
| | | G. Posch (Austria) | 2012-Present |
| C-III | Resistance Welding<br>1997: Resistance Welding and Allied Joining Processes<br>2003: Resistance and Solid State Welding and Allied Joining Processes | N.T. Williams (UK) | 1977-1996 |
| | | A.W.M. Bosman (The Netherlands) | 1996-2001 |
| | | K. Matsuyama (Japan) | 2001-2008 |
| | | M. Uran (Slovenia) | 2008-2014 |
| | | J.F. dos Santos (Germany) | 2014-Present |
| C-IV | High Energy Density Welding<br>2003: Power Beam Processes | G. Sayegh (France) | 1988-1996 |
| | | D. Russel (UK) | 1996-2002 |
| | | A. Matsunawa (Japan) | 2002-2007 |
| | | E. Levert (USA) | 2007-2011 |
| | | J.K. Kristensen (Denmark) | 2011-2012 |
| | | H. Staufer (Austria) | 2012-Present |
| C-V | Testing, Measurement and Control of Welds<br>2002: NDT and Quality Assurance of Welded Products | R. Sharpe (UK) | 1983-1990 |
| | | O. Forli (Norway) | 1990-1995 |
| | | T. Siewert (USA) | 1995-1999 |
| | | G. Dobmann (Germany) | 1999-2008 |
| | | P. Benoist (France) | 2008-2012 |
| | | E. Sjerve (Canada) | 2012-Present |

| WU | Title / History | Chairs | Dates |
|---|---|---|---|
| C-VI | Terminology | P. Stular (Yugoslavia) | 1976-1994 |
| | | O. Dellby (Sweden) | 1994-2002 |
| | | D. Rippergather (Germany) | 2002-2011 |
| | | G. Ziegenfuss (USA) | 2011-Present |
| C-VII | 1995-2000: Authorisation and Qualification | C. Ahrens (Germany) | 1995-2000 |
| C-VIII | Health and Safety<br>2007: Health, Safety and Environment | I. Grothe (W. Germany) | 1989-1993 |
| | | M. Kennebeck (USA) | 1993-1997 |
| | | G. McMillan (UK) | 1997-2006 |
| | | L. Costa (Italy) | 2006-2015 |
| | | W. Zschiesche (Germany) | 2015-Present |
| C-IX | Behaviour of Metals Subjected to Welding | I. Hrivnak (Czechoslovakia) | 1988-1994 |
| | | B. de Meester (Belgium) | 1994-2005 |
| | | T. Böllinghaus (Germany) | 2005-2014 |
| | | M. du Toit (Australia) | 2014-Present |
| C-X | Residual Stresses and Stress Relieving – Brittle Fracture<br>1997: Structural Performances of Welded Joints – Fracture Avoidance | A.A. Wells (UK) | 1979-1990 |
| | | F.M. Burdekin (UK) | 1990-1994 |
| | | S. Garwood (UK) | 1994-2000 |
| | | M. Koçak (Turkey) | 2000-2012 |
| | | F. Minami (Japan) | 2012-Present |
| C-XI | Pressure Vessels, Boilers and Pipelines | G.E. Stahl (W. Germany) | 1982-1991 |
| | | G. Gnirss (Germany) | 1991-2001 |
| | | M. Prager (USA) | 2001-2010 |
| | | T. Melfi (USA) | 2010-Present |
| C-XII | Flux and Gas-Shielded Electrical Welding Processes<br>2001: Arc Welding Processes and Production Systems | P. Drews (W. Germany) | 1986-1998 |
| | | M. Ushio (Japan) | 1998-2001 |
| | | W. Lucas (UK) | 2001-2010 |
| | | Y. Hirata (Japan) | 2010-Present |
| C-XIII | Fatigue Testing<br>2003: Fatigue of Welded Components and Structures | S. Maddox (UK) | 1988-2006 |
| | | G. Marquis (Finland) | 2006-2015 |
| | | K. A. Macdonald (Norway) | 2015-Present |

| WU | Title / History | Chairs | Dates |
|---|---|---|---|
| C-XIV | Welding Instruction<br>1994: Education and Training | M. Jacobi (W. Germany) | 1981-1996 |
| | | R. Long (USA) | 1996-2002 |
| | | W. Strippelmann (Germany) | 2002-2003 |
| | | R. Bonneau (Canada) | 2003-2005 |
| | | V. Hadrian (Switzerland) | 2005-2009 |
| | | V.Y. Matthews (USA) | 2009-2011 |
| | | C. Smallbone (Australia) | 2011-Present |
| C-XV | Fundamentals of Design and Fabrication for Welding<br>2001: Design, Analysis and Fabrication of Welded Structures | G. Costa (Italy) | 1986-1996 |
| | | A. Hobbacher (Germany) | 1996-2006 |
| | | R. Shaw (USA) | 2006-2015 |
| | | S. Botta (Italy) | 2015-Present |
| C-XVI | Welding of Plastics<br>1996: Polymer Joining and Adhesive Technology | H. Potente (W. Germany) | 1979-1997 |
| | | A. Benatar (USA) | 1997-2003 |
| | | C.Y. Wu (USA) | 2003-2009 |
| | | V. Schöppner (Germany) | 2009-Present |
| C-XVII | 2008: Brazing, Soldering and Diffusion Bonding | W. Miglietti (USA) | 2008-Present |

## Select Committees

| WU | Title / History | Chairs | Dates |
|---|---|---|---|
| SC-AIR | 1993: Aircraft Engineering<br>1995: Aircraft Materials Joining<br>2004: Permanent Joints in New Materials and Coatings for Aircraft Engineering | K. Yushchenko (Ukraine) | 1993-2002 |
| | | T. Mustaleski (USA) | 2002-2009 |
| | | I.D. Harris (USA) | 2009-2013 |
| | | S. Gong (P.R. China) | 2013-Present |
| SC-AL | Aluminium and Aluminium Alloys | M. Bramat (France) | 1985-1995 |
| | | C. Boucher (France) | 1995-1999 |
| SC- AUTO | 2002: Automotive and Road Transport | J. K. Larsson (Sweden) | 2002-2008 |
| | | M. Rethmeier (Germany) | 2008-Present |
| SC-ENV | 1999: Environment<br>2007: Combined with C-VIII | B. Pekkari (Sweden) | 1999-2000 |
| | | M. Scasso (Italy) | 2000-2007 |
| SC-MICRO | Microjoining<br>2011: Research Developments in Micro- and Nano-Joining Technologies | K. Johnson (UK) | 1984-1991 |
| | | N. Zhou (Canada) | 2011-Present |

| WU | Title / History | Chairs | Dates |
|---|---|---|---|
| SC- QUAL | 2001: Quality Management in Welding and Allied Processes | H. Köstermann (Germany) | 2001-2004 |
| | | R. Zwätz (Germany) | 2004-2010 |
| | | K. Middeldorf (Germany) | 2010-2013 |
| | | R. Shaw (USA) | 2013-Present |
| SC-STAND | Standardisation<br>2007: Became WG-STAND | M. Evrard (France) | 1986-1998 |
| | | D. Shackleton (UK) | 1998-2012 |
| | | M. Lundin (Sweden) | 2012-Present |
| SC-STS | Surfacing and Thermal Spraying<br>1999: Combined with C-I | M. Malik (Germany) | 1986-1999 |
| SC-UW | Underwater Welding<br>2005: Combined with C-XII | H. Hoffmeister (W. Germany) | 1984-1999 |
| | | I. Richardson (The Netherlands) | 1999-2005 |
| SC-SHIP | Shipbuilding | R. Boekholt (Spain) | 1990-2010 |
| | | H. Sadler (USA) | 2011-Present |

## Study Groups

| WU | Title / History | Chairs | Dates |
|---|---|---|---|
| SG-STI | Scientific and Technical Information<br>1995: became SG-STE: Technical and Economic Information | R. Bryant (UK) | 1982-1992 |
| | | N. Fauriol (France) | 1992-1995 |
| SG-STE | 1995: Technical and Economic Information<br>1999: Amalgamated with C-VI | N. Fauriol (France) | 1995-1998 |
| | | P. Adams (UK) | 1998-1999 |
| SG-RES | Welding Research Strategy and Collaboration | R. Dolby (UK) | 1989-2003 |
| | | L. Quintino (Portugal) | 2003-2012 |
| | | A. Scotti (Brazil) | 2012-Present |
| SG-212 | Physics of welding | J.F. Lancaster (UK) | 1965-1992 |
| | | G. den Ouden (The Netherlands) | 1992-2002 |
| | | E. Halmoy (Norway) | 2002-2005 |
| | | Y. Hirata (Japan) | 2005-2012 |
| | | M. Tanaka (Japan) | 2012-Present |

# BOARD OF DIRECTORS

## Task Groups

| WU | Title | Chairs | Dates |
|---|---|---|---|
| TG-FEES | Fees | D. Almeida (Brazil) | 2009-2013 |
| TG-GOV | Governance | C. Smallbone (Australia) | 2008-Present |
| TG-HIST | History of the IIW | C. Smallbone (Australia) | 2013-Present |
| TG-SEC | Secretariat Evaluation & Tender | B. Braithwaite (UK) | 1999-2001 |
| TG-WhiP | IIW White Paper | C. Smallbone (Australia) | 2006-2013 |
| TG-YL | Young Leaders | C.P. Ang (Singapore) | 2015-Present |

## Working Groups

| Acronym | Title | Chairs | Dates |
|---|---|---|---|
| WG-FAR | Finances, Audit and Risk | D. Luciani (Canada) | 2015-Present |
| WG-COM&MARK | Communications and Marketing (was Publications) | G. Costa (Italy) | 2000-2002 |
| | | M. Prager (USA) | 2002-2005 |
| | | C. Mayer (France) | 2005-2009 |
| | | S. Kanits (Austria) | 2009-2013 |
| | | M. du Toit (Australia) | 2013-Present |
| WG-RA | Regional Activities and Liaison with Developing Countries | C. Smallbone (Australia) | 1993-2005 |
| | | A. Rorke (Australia) | 2005-2008 |
| | | C. Smallbone (Australia) | 2008-Present |
| WG-STAND | Standardisation (was SC-STAND) | M. Evrard (France) | 1986-1998 |
| | | D. Shackleton (UK) | 1998-2012 |
| | | M. Lundin (Sweden) | 2012-Present |

# INTERNATIONAL AUTHORISATION BOARD FOR QUALIFICATION AND CERTIFICATION

| WU | Title | Chairs | Dates |
|---|---|---|---|
| IAB-Board | Board of the International Authorisation Board | D. Howden (USA) | 2000-2004 |
| | | D. von Hofe (Germany) | 2004-2005 |
| | | B. Pekkari (Sweden) | 2005-2008 |
| | | G. Hernandez (Spain) | 2008-2011 |
| | | U. Dilthey (Germany) | 2011-2014 |
| | | J. Guild (South Africa) | 2014-Present |
| IAB-Group A | Education, Training and Qualification | C. Ahrens (Germany) | 2000-2011 |
| | | H. Bodt (The Netherlands) | 2011-Present |
| IAB-Group B | Implementation, Authorisation and Certification | J. Hufsey (USA) | 2000-2003 |
| | | J. Guild (South Africa) | 2003-2011 |
| | | S. Morra (Italy) | 2011-Present |
| IAB-AAA | Asia, Africa, Australasia Region Representative | H. Nomura (Japan) | 2000-2005 |
| | | C.P. Ang (Singapore) | 2005-2008 |
| | | C. Smallbone (Australia) | 2008-2011 |
| | | J. Guild (South Africa) | 2011-2014 |
| | | C. Smallbone (Australia) | 2014-Present |
| IAB-ER | European Region Representative | D. von Hofe (Germany) | 2000-2004 |
| | | L. Johansson | 2004-2008 |
| | | S. Morra (Italy) | 2008-2011 |
| | | C. Eady (UK) | 2011-Present |
| IAB-AR | Americas Region Representative | A. McCartney (Canada) | 2000-2003 |
| | | R. Bonneau/ K.Longden (Canada) | 2003-2006 |
| | | E. Whalan (Canada) | 2006-2009 |
| | | C. Martin (Canada) | 2009-2012 |
| | | D. Almeida (Brazil) | 2012-2015 |
| | | J. Hufsey (USA) | 2015-Present |

# appendix 7

## IIW AWARDS

Each year the IIW honours significant contributions in the fields of welding and joining technology by awards which are presented during the Opening Ceremony of the Annual Assembly. Individuals are recognised for specific, outstanding, technical achievements, for their illustrious careers, and for long and meritorious service to the IIW.

Many IIW Awards pay tribute to eminent individuals who played a major role at some point in the organisation's history. Whether as founding fathers, champions or pillars of the technical Working Units, they contributed greatly to the furtherance of the IIW's aims and objectives and to the development of revolutionary scientific and technical advances in welding and allied processes.

For further details on each award and names of award winners please visit the IIW website www.iiwelding.org. Details of the 2016 IIW awards ceremony and winners are found at https://cld.bz/dVdVvcw

### Awards for Career Achievements and Contributions to IIW

*WALTER EDSTRÖM MEDAL – Sponsored by the Swedish Delegation*

Lauds an individual who has demonstrated outstanding leadership and remarkable contributions to the advancement of the IIW as an organisation.

*FELLOW OF THE IIW*

Recognises individuals within IIW who have made distinguished contributions to welding science and technology. Their outstanding accomplishments and technical impact will have advanced the science, technology and application of welding, and promoted and sustained the professional stature of the field.

*ARTHUR SMITH AWARD – Sponsored by the United Kingdom Delegation*

Conferred upon an individual who, over numerous years, has given dedicated service to the objectives of IIW, particularly in the work of the Commissions.

### *IIW REGIONAL ACTIVITIES AWARD – Sponsored by the Australian Delegation*

Conferred on an outstanding individual who, through involvement in the IIW, an IIW Member Society or outside of the IIW, has made a significant contribution to improving the global quality of life through optimum use and innovation of welding and joining technologies in their region or internationally.

### *RECOGNITION AWARDS*

For contributions at IIW Annual Assemblies over 10, 20, 30, and 40 years.

### *SERVICE AWARDS*

In appreciation of longstanding voluntary service by IIW Working Unit Chairs.

## Awards for Outstanding Technical Achievement

### *YOSHIAKI ARATA AWARD – Sponsored by the Japanese Delegation*

To an individual whose extraordinary achievements in fundamental research in welding-related science and technology have been recognised as significant contributions to the progress of welding engineering.

### *EVGENY PATON PRIZE – Sponsored by the National Welding Committee of the Ukraine and the E.O. Paton Electric Welding Institute*

For significant contribution to science and technology through lifetime dedication to applied research and development in the field of advanced technologies, materials and equipment for welding and allied processes.

### *HALIL KAYA GEDIK AWARD – Sponsored by the Turkish Delegation*

Recognising a scientist or engineer who has made outstanding contributions to the advancement of welding science and technology.

CATEGORY A – The development of consumables
CATEGORY B – The industrial implementation of arc welding
CATEGORY C – The training and education of young people

### *UGO GUERRERA PRIZE – Sponsored by the Istituto Italiano della Saldatura (Italy)*

Recognising an individual or team responsible for fabrication of an outstanding recently completed welded construction from the viewpoints of design, materials or fabrication methods.

### *ANDRÉ LEROY MEDAL – Sponsored by the French Delegation*

For the production of an outstanding large-circulation multimedia application intended for use in welding and allied education and training at any level.

*HEINZ SOSSENHEIMER AWARD – Sponsored by the German Delegation*

Open to modelling and simulation software documents which cover any aspect of joining and allied processes and which significantly contribute to the improvement of both the quality and safety of joining, cutting or surfacing operations.

*HENRY GRANJON PRIZE – Sponsored by the Institut de Soudure (France)*

Outstanding papers devoted to research into welding and related technologies authored by younger members of the welding community.

CATEGORY A – Joining and Fabrication Technology
CATEGORY B – Materials Behaviour and Weldability
CATEGORY C – Design and Structural Integrity
CATEGORY D – Human Related Subjects

WELDING IN THE WORLD *BEST PAPER AWARD – Sponsored by the IIW*

The best industrial, research or academic paper published in Welding in the World in the calendar year prior to the award.

*K. EASTERLING AWARD*

Given at the IIW *International Seminar Numerical Analysis of Weldability* for a paper describing the best contribution made over the two preceding years on the advancement of knowledge or practice in respect of mathematical modelling of weld phenomena.

## Honorary Lectures

*THOMAS MEDAL – Sponsored by the American Welding Society*

Awarded to an eminent person, with significant involvement in IIW/ISO international standards activities, who can deliver an AWS lecture illustrating the incorporation of global studies into the standardisation of welding technology.

*HOUDREMONT LECTURE*

Keynote lecture at alternate IIW International Conferences held in association with Annual Assemblies and given by a distinguished person who demonstrates considerable knowledge within the theme of the conference and has been working and publishing in that field.

*PORTEVIN LECTURE*

Keynote lecture at alternate IIW International Conferences held in association with Annual Assemblies and given by a distinguished person who demonstrates considerable knowledge within the theme of the conference and has been working and publishing in that field.

*JAEGER LECTURE*

Opening address at an IIW International Congress which elaborates on the theme of that Congress and references the achievements, challenges and potentials for the welding industry as a whole in the region where the Congress is held. Presented by an eminent and experienced person from local industry, academia or government in the host country or Congress region.

# appendix 8

## IIW ANNUAL ASSEMBLIES AND INTERNATIONAL CONFERENCES

IIW events such as the Annual Assembly and International Conference, hosted by Member Societies in locations around the world, provide unique opportunities for experts, practitioners and accompanying persons to meet and network at both professional and personal levels. Since 1983 a concurrent International Conference has facilitated access for the local welding industry and young professionals to international experts and leading-edge research and technology, and provided a platform for showcasing developments in the host nation to the welding world.

| Year | Annual Assembly | Parallel International Conference |
|---|---|---|
| 2016 | Melbourne, Australia | From Concept to Decommission: The Total Life Cycle of Welded Components |
| 2015 | Helsinki, Finland | High Strength Materials – Challenges and Applications |
| 2014 | Seoul, South Korea | Advanced Technology in Welding and Joining for Heavy, Automotive and Electronics Industries |
| 2013 | Essen, Germany | Automation in Welding |
| 2012 | Denver, USA | Welding for Repair and life Extension of Plants and Infrastructure |
| 2011 | Chennai, India | Global Trends in Joining, Cutting and Surfacing Technology |
| 2010 | Istanbul, Turkey | Advances in Welding Science and Technology for Construction, Energy & Transportation Systems |
| 2009 | Singapore | Advances in Welding and Allied Technologies |
| 2008 | Graz, Austria | Safety and Reliability of Welded Components in Energy and Processing Industry |
| 2007 | Dubrovnik, Croatia | Welding and Materials Technical, Economic and Ecological Aspects |
| 2006 | Québec City, Canada | Tubular Structures |
| 2005 | Prague, Czech Republic | Benefits of New Methods and Trends to Economy, Productivity And Quality |

| Year | Annual Assembly | Parallel International Conference |
|---|---|---|
| 2004 | Osaka, Japan | Technical Trends and Future Prospectives of Welding Technology for Transportation, Land, Sea, Air and Space |
| 2003 | Bucharest, Romania | Welded Construction for Urban Infrastructure |
| 2002 | Copenhagen, Denmark | Advanced Processes and Technologies in Welding and Allied Processes |
| 2001 | Ljubljana, Slovenia | Joining Technologies of Dissimilar Materials and Structural Integrity Problems of Jointed Materials |
| 2000 | Florence, Italy | Welded Constructions : Achievements and Perspectives for the New Millennium |
| 1999 | Lisbon, Portugal | The Human Factor and its Environment |
| 1998 | Hamburg, Germany | Welding in Shipbuilding |
| 1997 | San Francisco, USA | Performance of Dynamically Loaded Welded Structures |
| 1996 | Budapest, Hungary | Welded Structures, in Particular Welded Bridges |
| 1995 | Stockholm, Sweden | Welding of Stainless Steel |
| 1994 | Beijing, China | Advanced Techniques and Low Cost Automation |
| 1993 | Glasgow, UK | Extending the Life of Welded Structures |
| 1992 | Madrid, Spain | Engineering Design in Welded Constructions |
| 1991 | The Hague, The Netherlands | Joining/Welding 2000 |
| 1990 | Montreal, Canada | Advances in Joining Newer Structural Materials |
| 1989 | Helsinki, Finland | Welding Under Extreme Conditions |
| 1988 | Vienna, Austria | Weld Quality: The Role of Computers |
| 1987 | Sofia, Bulgaria | Stress Relieving Heat Treatments of Welded Steel Constructions |
| 1986 | Tokyo, Japan | Electron and Laser Beam Welding |
| 1985 | Strasbourg, France | Automation and Robotisation in Welding and Allied Processes |
| 1984 | Boston, USA | Welding of Tubular Structures |
| 1983 | Trondheim, Norway | Underwater Welding |

| Year | Annual Assembly |
|---|---|
| 1982 | Ljubljana, Slovenia |
| 1981 | Porto, Portugal |
| 1980 | Estoril, Portugal |
| 1979 | Bratislava, Slovakia |
| 1978 | Dublin, Ireland |
| 1977 | Copenhagen, Denmark |
| 1976 | Sydney, Australia |
| 1975 | Tel-Aviv, Israel |
| 1974 | Budapest, Hungary |
| 1973 | Düsseldorf, Germany |
| 1972 | Toronto, Canada |
| 1971 | Stockholm, Sweden |
| 1970 | Lausanne, Switzerland |
| 1969 | Kyoto, Japan |
| 1968 | Warsaw, Poland |
| 1967 | London, UK |
| 1966 | Delft, The Netherlands |
| 1965 | Paris, France |

| Year | Annual Assembly |
|---|---|
| 1964 | Prague, Czechoslovakia |
| 1963 | Helsinki, Finland |
| 1962 | Oslo, Norway |
| 1961 | New York, USA |
| 1960 | Liège, Belgium |
| 1959 | Opatija, Croatia |
| 1958 | Vienna, Austria |
| 1957 | Essen, Germany |
| 1956 | Madrid, Spain |
| 1955 | Zurich, Switzerland |
| 1954 | Florence, Italy |
| 1953 | Copenhagen, Denmark |
| 1952 | Göteborg, Sweden |
| 1951 | Oxford, UK |
| 1950 | Paris, France |
| 1949 | Delft, The Netherlands |
| 1948 | Brussels, Belgium |

# appendix 9

## IIW INTERNATIONAL CONGRESSES AND COLLOQUIA

IIW International Congresses hosted by Member Societies in regions around the world, bring together people from industry, government and training bodies to promoting appropriate welding technologies and share ideas on how the improvement of welding in the region could lead to raising the general quality of life of people through the IIW WeldCare programme. Congresses also promote the benefits available through IIW expertise, knowhow, and education, training, qualification and certification programmes for the advancement of nations in the region.

IIW Welding Research and Collaboration Colloquia provide a unique opportunity for international researchers from universities, industries and governments to meet, present, and discuss the research and development work they are conducting, or planning to do, alone or in cooperation with other researchers. They provide unique networking and career promotion opportunities for young professionals and encourage participation in IIW Annual Assemblies and technical Working Units.

**A calendar of future events is found on the IIW website www.iiwelding.org**

## IIW International Congresses

| Year | Host Country | Title of Congress |
|---|---|---|
| 2015 | Romania | 3rd IIW South East European IIW International Congress: Welding and Joining Technologies for a Sustainable Development and Environment, Timişoara |
| 2014 | India | 3rd IIW International Congress: Advancement in Welding, Cutting & Surfacing Technologies for Improved Economy, Reliability & Sustainable Environment, New Delhi |
| 2014 | Canada | 1st IIW International Congress in the Arctic Region, Vancouver |
| 2014 | Brazil | 1st Pan American IIW International Congress, Sao Paulo |
| 2013 | Singapore | Asia-Pacific IIW International Congress: Recent Development in Welding and Joining Technologies, Singapore |

| Year | Host Country | Title of Congress |
|---|---|---|
| 2012 | South Africa | 3rd IIW International Congress: Advancing Science and Technology of Welding in Sub-Saharan Africa, Johannesburg |
| 2011 | Australia | Asia-Pacific IIW International Congress: Improving quality of life Through Welding, Cairns |
| 2011 | Turkey | IIW International Congress: Advances in Welding Science and Technology for Construction, Energy and Transportation Systems, Antalya |
| 2010 | Bulgaria | 2nd South East European IIW International Congress: Welding – HIGH-TECH Technology in 21st Century, Sofia |
| 2010 | Tunisia | 2nd IIW International Congress: Welding and Related Techniques, Hammament |
| 2010 | Thailand | 2nd South East Asia IIW International Congress: Technology-Education-Quality Management, Bangkok |
| 2010 | Israel | 2nd IIW International Congress: Welding for Water Technologies, Tel Aviv |
| 2009 | Iran | 4th IIW International Congress, Tehran |
| 2009 | Slovakia | 1st Central European IIW International Congress: Progressive Structural Materials and their Joining Technologies, High Tatras |
| 2009 | Nigeria | 1st West African IIW International Congress, Abuja |
| 2008 | P.R. China | Asia-Pacific IIW International Congress 'Change, Chance and Challenge in Welding Technology', Tianjin |
| 2008 | Brazil | 2nd Latin American IIW International Congress, Sao Paulo |
| 2008 | India | 2nd IIW International Congress: Technological and Material Challenges in Welding, Fabrication and Inspection, Chennai |
| 2007 | Australia | Asia-Pacific IIW International Congress, Sydney |
| 2006 | Thailand | 1st South East Asia IIW International Congress: Welding in South-East Asia: A Challenge for the Future, Bangkok |
| 2006 | Romania | 1st South-East European IIW International Congress: Welding and joining technologies for a sustainable development and environment, Timișoara |
| 2006 | South Africa | 2nd IIW International Congress: Welding and Related Inspection Technologies for the Development of Southern Africa, Cape Town |
| 2005 | India | 1st IIW International Congress: Frontiers of Welding Science and Technology, Mumbai |

| Year | Host Country | Title of Congress |
|---|---|---|
| 2005 | Israel | 1st IIW International Congress: Welding and Joining 2005: Frontiers of Materials Joining, Tel Aviv |
| 2004 | Egypt | 1st IIW International Congress: Welding and Allied Processes, Cairo |
| 2003 | Iran | 3rd IIW International Congress, Tehran |
| 2002 | Singapore | Asia-Pacific IIW International Congress, Singapore |
| 2002 | Iran | 2nd IIW International Congress, Tehran |
| 2000 | Australia | Asia-Pacific IIW International Congress, Melbourne |
| 1998 | Iran | 1st IIW International Congress, Tehran |
| 1997 | South Africa | 1st IIW International Congress, Johannesburg |
| 1996 | New Zealand | Asia-Pacific IIW International Congress, Auckland |
| 1992 | Brazil | 1st Latin American IIW International Congress, Rio De Janeiro |
| 1988 | Australia | Asia-Pacific IIW International Congress, Hobart |

## IIW Welding Research and Collaboration Colloquia

| Year | Host Country | Title of Colloquium |
|---|---|---|
| 2016 | India | 6th IIW Welding Research and Collaboration Colloquium, Hyderabad |
| 2015 | Germany | 5th IIW Welding Research and Collaboration Colloquium, Limburg |
| 2014 | Australia | 4th IIW Welding Research and Collaboration Colloquium, Wollongong |
| 2013 | Brazil | 3rd IIW European-South American School of Welding and Correlated Processes, Salvador |
| 2012 | Austria | 2nd IIW European-South American School of Welding and Correlated Processes, Wels |
| 2011 | Brazil | 1st IIW European-South American School of Welding and Correlated Processes, Ouro Preto |

# appendix 10

## FINANCIAL SPONSORS OF THIS WORK

IIW would like to acknowledge the following IIW Member Societies (in alphabetical order) for their generous support of the development and publication of this book, *Linking People, Joining Nations: The impact of the International Institute of Welding (IIW) since 1990.*

American Welding Society

Canadian Welding Bureau

Chinese Welding Society

Deutscher Verband für Schweissen und verwandte Verfahren e.V. (Germany)

Gedik Education and Social Benefits Foundation (Turkey)

Institut de Soudure (France)

Istituto Italiano della Saldatura (Italy)

Japan Institute of Welding

Karaganda State Technical University (Kazakhstan)

Singapore Welding Society

National Agency for the Control of Welding (Russian Federation)

Nigerian Institute of Welding

Norsk Sveiseteknisk Forbund (Norway)

Schweizerischer Verein für Schweisstechnik (Switzerland)

Southern African Institute of Welding

Suomen Hitsausteknillinen Yhdistys ry. (Finland)

Welding Technology Institute of Australia

The support of the Institut Belge de la Soudure – Belgisch Instituut Voor Lastechniek (Belgium) is also acknowledged.

The financial support of the project by Ass. Prof. Dr-Ing. Petar Darjanov and Dr-Ing. Marin Beloev of the Bulgarian Welding Society is also appreciated.

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