

Hydro-Informatics and IAHR II



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This article retraces in a short way the history of the reciprocal influences between development of application of computers and then of ICT in the fields of hydraulics on the one hand and IAHR on the other. This is described through the evolution of IAHR and its interest in the field as expressed by the creation and activities of the Committee and the Technical Section, originally called 'On the Use of Computers in Hydraulics', then 'Computational Hydraulics' and, finally, 'Hydroinformatics'. The period covered is from 1960 to 2005.

The very term hydroinformatics appeared only around 1990. Employed and accepted world-wide today, it was created within the IAHR environment, actually invented by one of our now honorary members and institutionalised within the Association by a group of its active members. This is a result of some 45 years of influence exerted by the scientific and technological evolution of Information and Communications Technologies (ICT) on hydraulics and on IAHR. Having two papers devoted to hydroinformatics in this special commemorative issue shows the importance that IAHR currently attributes to the domain, but over these years the relations between the domain and the Association were interactive. In some periods IAHR was indifferent or even reticent although important progress was made in this field by the profession. In other periods it was IAHR (or, rather, its Council, Divisions or Committees) that itself gave the vital impulse to research and engineering developments.

IAHR was founded by a group of people who were both researchers and what we call today practitioners. By the very character of hydraulics as an experimental science, every practical application of some importance comprises a number of 'unsolved' or, if one prefers, 'new' problems. Thus it is difficult if not impossible to design and implement important engineering structures or river regulation works without doing applied and sometimes more fundamental research. Historically it was impossible to separate practice from research, empirical results and parameters from hydrodynamic theories, final design from scale models and, hence, from similarity theory and practice. It is enough to consult the list of names of our 'founding fathers' (namely Danel, Egiazaroff, Fellenius, Hellström, Inglis, Ippen, De Marchi, Meyer-Peter, Seifert, Smetana, Straub and Thijssse as Council members in its early period, ending around 1950) to realise these close links as well as between this community and its teaching.

It then became necessary to consider research, practice and teaching, a combination still valid, and now even more so because hydraulics is still an experimental applied science with many practical problems for which theoretical solutions do not exist. But the perception of this situation has been modified since the 1950s through a number of factors:

- The revolution in scale of the means that are available for prosecuting engineering works in terms of budget, quantities of material, machines and number of projects.
- The experience developed over decades of providing a number of standard solutions and approaches.
- The development and understanding of similarity theory that has largely standardised scale modelling.

These factors combined to produce a situation whereby the gains obtained by improving or optimising hydraulic design (except possibly for hydraulic turbines) usually concerned only a small part of large projects and systems.

IAHR was directly influenced and affected by this evolution. During the General Assembly of 1948 only one major contribution was presented by Meyer-Peter and Müller describing their famous bed-load formula. The attendance was composed largely of people who were both researchers and practitioners. Since then the attendance of Congresses has changed following the development of IAHR's membership: over the years membership came more and more from academia and research, and the profile became more and more distinct from that of practitioners. In parallel with this evolution, computers stormed their way into, and revolutionised, hydraulics, beginning in the late 1950s. The 'coming out' of computer applications and their claim to be recognised occurred during the 9th Congress in Dubrovnik in 1961. A special theme 'Hydraulic Problems for Computers' was accepted and over 40 papers on computer applications were presented, out of which only one third were authored by researchers. The majority came from practitioners, consultants and contractors. From one private consulting company, SOGREAH, alone, 13 papers were published. Even though this new approach came from practice, it was met within the profession, and within IAHR also, with mistrust and even hostility, provoked partially by ordinary conservatism but also by the fear that numerical simulation and modelling might replace scale modelling that had by then become customary. This attitude was reinforced by the presence of computer enthusiasts who knew little of hydraulics but were convinced that in a few years reduced-scale-model laboratories would disappear.

This controversy was reflected within IAHR. Thus it was only at the beginning of the 1970s that there appeared a

possibility to formalise the existence of what meanwhile was evolving into a new branch of hydraulics by creating a specific Committee within a Technical Division. Indeed, after more than a decade of engineering developments and applications, mainly carried out by European organisations (SOGREAH, then Electricité de France EDF, and then the Danish Hydraulics Institute, HR Wallingford and Delft Hydraulics), it took nearly another decade, to convince IAHR to create a Committee and then a Section 'On the Use of Computers in Hydraulics', officially in 1975, during the Sao Paulo Congress. It is important to underline the historical role of individuals who obtained this recognition, either because they were active IAHR members or because they were pioneers or even creators of Computational Hydraulics and engineering applications of numerical models, or,



often, both: Francis Biesel and Alexandre Preissmann and their colleagues from SOGREAH; André Daubert and his colleagues from LNH/EDF, Chatou; Mike Abbott from IHE and DHI; Vujica Yevjevich from Fort Collins, Colorado. It was definitely M.B. Abbott who played an essential role and succeeded in the creation of the Committee of which he was the first President. This Committee worked over several years to make IAHR understand that the mere application of computers was actually a thing of the past, because the processes of modelling with computers led to new developments linking together Applied Mathematics, the formulation of a number of experimental physical laws of hydraulics under the form of new equations, algorithmic and numerical solution methods and even programming. All of this together constituted a new way of looking at hydraulics problems that up to that time had

been based solely on laboratory experience, and this led to a new branch of hydraulics: computational hydraulics. Hydraulics was and still is an experimental science but the word 'experiment' acquired also a computational connotation and even another meaning. This was acknowledged and recognised by the Council. There were several reasons lurking in the background that changed the attitude of both academia and the profession. The engineering applications multiplied not only within the ambit of European institutions. In 1975 more than 200 American engineers including members of the US Army Corps of Engineers participated for three weeks in a Colorado State University Summer School organised by V. Yevjevich. The input of invited European lecturers, all active IAHR members, was essential. From this date onwards, American engineers launched themselves into the domain. Numerous scientific publications authored by the members of the Section on the Use of Computers were considered important by the international scientific community. Some European consultants, Corporate Members of the IAHR, were using modelling systems as everyday tools. An important role was played by EDF: Michel Hug and Jean Pierre Benqué were important agents in obtaining this recognition. Remarkable in its high quality and the considerable effort that it entailed, an exhibition on numerical modelling organised by the Committee in Baden Baden during the 1977 Congress, on the initiative of M.B. Abbott, begun a new era. A noticeable fact concerning this exhibition, as well as nearly everything described in the subsequent actions of the Committee, is that they were financed voluntarily by this small group of consultants, corporate IAHR members and practitioners who understood the importance and benefit of these new developments to the whole profession.

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The period of some 10 years that followed was remarkable. The Committee changed its name to 'Computational Hydraulics', but that was only the tip of the iceberg. Most of the Committee members were, reflecting previous IAHR history, both practitioners and researchers. Thanks to that it was possible in the late 1970s and in 1980s to carry on, within IAHR, the activities that eventually had a decisive influence on developments in practice. Most of the Committee members worked for organisations that were often in ferocious competition for contracts. The development of numerical simulation systems was used as a commercial argument and the results as tools. How was the engineering profession to ensure the scientific and technological quality of both the tools and the studies carried out with these tools? How was it to overcome, for the benefit of scientific progress and the widening of applications, the defence reflexes coming from the field of commercial

competition? The Committee on Computational Hydraulics decided to organise informal symposia with the invited attendance of some 30 people. The principle was simple: no written proceedings, no right to use as commercial arguments the information obtained, but the obligation of everyone to everyone to explain his codes in all details, answer all questions, and show all artefacts and 'tricks' in the codes. The first effective symposium of this kind was held at the invitation of DHI in Elsinor, with dinner at the Castle of Hamlet fame, in Denmark. It was called in the name of IAHR by M.B. Abbott (IHE/DHI), J.A. Cunge (SOGREAH), J.-P. Benqué and A. Hauguel (LNH/EDF), T.J. Weare (Wallingford) and G. Verboom (WL Delft). It was, most significantly, financed by the competing institutions because the IAHR Committee members convinced them to do this for the sake of building a healthy new industry. The impact on the profession was considerable: numerical modelling became considered as something trustworthy, of a quality guaranteed by mutual control and respect of its most important representatives. These Symposia were held every two-to-three years until 1994, up to the date of 1st Int. Conference on Hydroinformatics in Delft. These events laid the foundation for the hydraulic engineering branch of numerical simulation.

The dynamics created by this response of the profession helped the Section in setting up its own scientific and application activities. It participated in a number of specialised symposia and conferences and became responsible, in a systematic way, for one of the sessions of each subsequent IAHR Congress. The exhibition on numerical models and applications became a standard event of the Congresses. The Committee members were stimulated by personal friendship and respect, while competing commercially, to publish papers on new developments. They even issued a common 'warning note' for the engineering profession in the name of the Committee, and of all the important model-developing institutions (Abbott et al. 1986). This publication, unique in engineering history, demystifies numerical simulation modelling and shows its limitations and the dangers of its misuse.

The end of the 1980s saw a new professional situation again. Modelling software tools became, with the evolution of ICT, mass market tools and came to be used by nearly all engineering companies. On the other hand, hydraulics, or rather its position in society, changed, in that:

- Engineers lost their dominant and even monopolistic position in decision-making; technical solutions became only a part of the whole range of activities that had also to satisfy social requirements.
- The consideration of social requirements as a whole, and not just the engineering aspects, quite suddenly rendered obsolete the traditional approaches to studies and design.

This development led to “hydroinformatics”. The word itself was proposed by M.B. Abbott. The content, however, stems from social requirements: it aims at the development and application of technologies to make possible an understanding and the elaboration of common views between water engineers and other sciences (biology, ecology, social sciences) as well as decision makers (politicians, governments, NGOs and citizens). This idea has been promoted by the IAHR Hydroinformatics Committee. The concept and its acceptance and assimilation by the engineering profession were essentially introduced by four major steps:

- The ‘Hydroinformatics’ book written by M.B. Abbott in 1991;
- The ‘Hydroinformatics’ extra issue of the Journal of Hydraulic Research in 1994;
- The International Hydroinformatics Conferences first in Delft in 1994; and subsequently in Zürich in 1996, in Copenhagen in 1998 and held bi-annually since;
- The Hydroinformatics Committee created in 1994 with IWA and, later, IAHS, of the ‘Journal of Hydroinformatics’.

The Hydroinformatics Section and its predecessors have thus been carrying out many important tasks of knowledge-dissemination and professional-cohesion for the last 35 years. Several book series and papers were published under the direct and explicit impulses of the Section and authored by Section members. International Conferences on Hydroinformatics were held regularly since 1994, every second year, with large and enthusiastic attendances. The next Hydroinformatics Conference will be held in Nice in 2006.

Hydroinformatics is now recognised as a discipline in its own right. IAHR has played an important and sometimes decisive role in the development of the domain and the acceptance of its avatars, continuing into its current body, and continues to do it mainly through the technical Committee and the Section. In turn, the Committees on the Use of Computers in Hydraulics, on Computational Hydraulics, and on Hydroinformatics, has repaid the Association with a number of officers from the Committee ranks, including one President of the Council. More importantly still, the present place of hydroinformatics has been attained by a constant interaction between its own engineering practice and research/development activities and the activities of the IAHR. These links have now become strong and one can hope that they will continue to remain so in the future.

REFERENCES

Abbott, M.B., Berkhoff, J.C.W., Cunge, J.A., Hauguel, A., Warren, I.R., Weare, T.J. (1986) “Computer Modelling: a Warning Notice on behalf of IAHR Computer Section”, Dock and Harbour Authority 67(3), 251-256.



Figure1. Terraview Stormwater Management Pond (Credit: Q. Rochfort)