

Past, Present and Future Plans of the International Building Performance Simulation Association – IBPSA

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Summary

This paper gives an overview of the history and current state of the International Building Performance Simulation Association (IBPSA) including its growing number of regional affiliate organizations. The results of a recent survey among potentially in IBPSA interested parties in The Netherlands, Belgium and Luxembourg is presented. Finally IBPSA's future plans are summarized.

Past and Present of IBPSA

Building performance modelling and simulation by means of computers (analogue at first) started way back in the 1950-ies. One of the first applications involved the use of analogue computers to predict two-dimensional dynamic heat transfer through building constructions. The 1960-ies saw the advent of digital computers in many engineering fields including ours. It was not long before the first building performance simulation software was created.

A very interesting overview of the state-of-play and future expectations by the end of the 1960-ies (!) is contained in the proceedings of the - probably - first ever international building performance simulation conference which was organized in the USA in 1970 (1). At this conference authors from 11 different countries presented 62 papers. The topics included basics (heat transfer by conduction and convection, solar effects, weather data, etc.), load and energy calculations, analogue computing & time-sharing, and computer graphics. The Netherlands was very well represented with papers by Oegema and Euser (2) and by Boeke and Larm (3).

The 1970-ies saw an accelerated uptake of building performance simulation research, development and application, amongst other important results culminating in various PhD theses abroad (e.g. 4) and in The Netherlands (5, 6 and 7).

It was not until the 1980-ies that researchers and other interested parties recognized the need for some sort of organization that would allow them to exchange ideas, to share experiences and to transfer knowledge and results to a wider audience. Researchers in Belgium were forerunners in this respect with the early establishment of the Building Analysis Group, an organization that is still very active today (8).

Unfortunately a similar venture in The Netherlands (9) was only short lived. It was at a conference in the USA (10) where the idea to create an international organization was launched. Eventually this resulted in the 1987 incorporation of IBPSA, the International Building Performance Simulation Association.

IBPSA's principal mission is to promote and advance the practice of building performance simulation in order to improve the energy and environmental performance of new and existing buildings worldwide. IBPSA seeks to achieve its goals through the establishment of a range of products and services aimed at informing and equipping those who are involved in the construction industry and who seek to utilize computer-based tools to good effect. To this end, IBPSA Strategic Plan identifies nine specific areas that encompass the organization's activities. These are:

1. Strategic Alliances with professional organizations such as the engineering and architectural societies. The intention is to engender a better understanding of the profession's requirements and the technology's potential.
2. International Conference Series to periodically collate and preserve those developments that comprise the current state-of-the-art.
3. Technical Development Program aimed at influencing the direction the technology of building simulation might take at any given point in time.
4. Educational Initiatives concerned with the teaching of building simulation in the higher education institutions and in the context of continuing professional development.
5. Harmonization Activities in an attempt to regularize the application of the different modelling systems through the definition of standard methods for performance assessment and the provision of standard support data.
6. Member Recruitment aimed at extending the IBPSA products and services to those practitioners who can most benefit from the new technology.
7. Products and Services devised in response to the profession's evolving needs.
8. Technology Transfer concerned with the delivery of training in all aspects of computer-based performance assessment at all stages of the building life cycle.
9. Regional Development to subject the foregoing activities to appropriate regional influences and enable their effective delivery.

The current state is that IBPSA has achieved significant success at the international level - largely through its biannual conference program: Vancouver '89, Nice '91, Adelaide '93, Wisconsin '95, Prague '97, Kyoto '99, and the next one in Rio de Janeiro in 2001. The conferences show a continuous growth. Building Simulation '99 in Kyoto (11) saw some 250 delegates from 25 countries presenting 183 papers covering a wide range of topics that may be categorized as follows.

- **Basics:** moisture, acoustics, air quality, daylighting, human factors, fluid flow modelling, electrical power flow, solar radiation and shading, HVAC systems and components, heat transfer and thermodynamics, etc.
- **Tools:** integration, visualization, interoperability, next generation, detailed design phase energy tools, tools for early design phase, tools for urban level analysis, etc.
- **Analysis:** life cycle analysis, IAQ & thermal comfort, HVAC performance analysis, building energy performance, low-energy cooling techniques, daylighting vs. electric lighting, HVAC fault detection and diagnosis, building integrated power generation, and HVAC operation, control & management optimisation.
- **Quality assurance:** training, practical guidelines, empirical validation, uncertainty analysis, analytical verification, calibration procedures, intermodel comparisons, simulation and the real world, input data: weather information, occupancy, ..., etc.
- **Technology transfer:** education and training, history and future prospects, simulation in building design practice, and IBPSA affiliate organizations.

IBPSA has also been successful with its web based services and worldwide electronic mailing facility. However IBPSA has had to recognize the difficulties surrounding the development of additional global products and services that are appropriate to the day-to-day needs of its members. This is mainly due to the geographical spread of IBPSA members, which is wide, and gives rise to a requirement to cover disparate work practices, technologies and professional needs.

IBPSA realized that if the construction industry is to be well supported in its attempts to harness effectively the emerging IT and simulation technologies then regionally based support organizations are essential. This necessitated the creation of a structure by which such organizations could affiliate in order to disseminate their know-how and promote their local best practice. Only in this way could the benefits of the new technology be understood and future standardization enabled. It was with the view of a network of autonomous regional organizations that IBPSA has turned to regionalization and is encouraging existing or newly formed groups to become IBPSA affiliates, as was done earlier by IBPSA Australasia, IBPSA Canada, IBPSA Czech Republic, IBPSA France, IBPSA Ireland, IBPSA Japan, IBPSA Slovakia, IBPSA UK / BEPAC, and IBPSA USA.

A Regional IBPSA Affiliate Organization

The symposium “Models for building and systems simulation”, on 19 October 1999 in Delft, was very well attended. One of the conclusions of the symposium was that there clearly is considerable interest in establishing an IBPSA affiliate organization in the region. At the symposium and afterwards the following two aspects were discussed at length.

- Which activities should and could be done by our regional organization?
- Should our region be constrained to The Netherlands, or would it be more sensible to co-operate with Flanders, or Belgium and perhaps Luxembourg?

In order to be able to address these questions with some authority it was decided to launch a survey amongst the 1999 symposium participants and as many as possible other potentially interested persons.

Building and Systems Simulation - survey results

A paper-based version of the survey was distributed via regular mail and electronic copies were made available on the Internet¹ in both a PDF version and in HTML format. The survey ran from June through to October 2000.

In order to accommodate non-Dutch speaking respondents, the questions and explanatory remarks were both in Dutch and in English.

Although several attempts were made to generate more responses – especially from Belgium – the total number of respondents is 43 of which only 4 from Belgium (non from the French speaking part).

The first part of the survey refers to personal data such as affiliation and address and will not be presented here.

The results for the question “**Below are a number of simulation areas and some aspects which might be relevant for you. Please indicate your areas of interest and whether or not you are using - or intend to use - software in those areas**” are as follows.

Area or aspect	This is of interest to me	I use software in this area	I plan to use software in this area in the future
Building physics including heat, air and moisture flow, heating and cooling loads, electric and day lighting, acoustics and smoke transport.	25 (58%)	34 (79%)	4 (9%)
Heating, ventilation and air-conditioning systems	29 (67%)	26 (60%)	7 (16%)
Control and operation of building and building systems	27 (63%)	10 (23%)	8 (19%)
Energy supply systems including renewable energy systems, thermal storage systems, district heating and cooling, combined heating and power	26 (60%)	19 (44%)	8 (19%)

¹ See <http://www.bwk.tue.nl/fago/IBPSA/>

systems			
Human factors including health, productivity, thermal comfort, visual comfort, acoustical comfort and indoor air quality	26 (60%)	19 (44%)	6 (14%)
Building services such as lighting systems, sound/vibration control systems, fire/smoke and emergency control systems, cold/hot water supply systems, sewerage systems	16 (37%)	11 (26%)	8 (19%)
Advances and recent developments in modelling and simulation such as product modelling, software inter-operability and coupling with CAD	32 (74%)	11 (26%)	8 (19%)
Use and user aspects such as user interface, knowledge transfer, training and education	29 (67%)	6 (14%)	8 (19%)
Quality aspects such as accreditation, methodology, validation, verification and calibration	28 (65%)	6 (14%)	5 (12%)

The results for the question “**Are you interested in simulation applications or aspects other than indicated above?**” may be summarized – in no particular order – as follows.

- Integrated approaches
- Standardized approaches
- Economical and life-cycle aspects
- Maintenance aspects
- Design decision support systems
- Coupling with ICT
- Infrastructure aspects
- Optimisation of complex building systems

The results for the question “**How are you informed about currently available models, about soon to be released models or about future developments?**” are as follows.

Publications	38 (88%)
Seminars, workshops, etc.	32 (74%)
Other	16 (37%)

Where the “**Other**” replies may – in no particular order - be summarized as:

- World wide web and electronic discussion groups
- Personal contacts with researchers, research institutes and companies
- National and international co-operation in research

The results for the question “**Do you think that a regional IBPSA affiliate organization would be sensible?**” are as follows.

Yes	39 (91%)
Perhaps	1 (2%)
No	2 (5%)

The results for the question “**If yes, please indicate your preferred region(s) and language**” are as follows.

IBPSA Netherlands (Dutch)	7 (16%)
IBPSA Netherlands + Flanders (Dutch)	23 (53%)
IBPSA Benelux (English)	11 (26%)

Next the survey put forward some pointers regarding “***What a regional IBPSA affiliate organization could do***”.

- *Transfer of knowledge and information, to a wide spectrum of potential users and beneficiaries, about good (and bad) examples of practical applications, about applications in general, about limitations, and about quality aspects of building simulation in general (i.e. not only when used for energy performance prediction in the detailed design phase, but also earlier in the design process, during the full life cycle of the building, and including other aspects such as light, sound, moisture, health, etc.).*
- *To provide a forum/platform for users and developers of building simulation software for discussion purposes and exchange of ideas, and - for example - for standardization/harmonization of assumptions related to user behaviour, weather data, material data, etc.*
- *Development of strategic alliances with for example ISSO, TNO, VABI, ECN, NOVEM, TVVL, VNI, VNA, SBR, etc.*
- *Development and maintenance of a website with public and members-only activities and services.*
- *Promoting quality assurance in the application of building simulation.*
- *Promoting relevant training and (higher) education.*
- *Promoting accreditation of building simulation software.*
- *Producing and distributing an electronic newsletter.*
- *Representing the region in IBPSA.*
- *Organizing seminars, mini-symposia, etc.*

The results for the question “**Do you have any other suggestions regarding possible activities of a regional IBPSA affiliate organization?**” can – in no particular order – be summarized as follows.

- To develop target group oriented activities; e.g. through special interest groups.
- To provide and maintain an extended diary of events (conferences, workshops, seminars, call for proposal deadlines, etc.) not restricted to IBPSA organized events.
- To make use of the knowledge and experience available in smaller specialized engineering offices; i.e. not to restrict knowledge transfer to what is available at large research institutes and consulting engineering offices.

- To contact/ co-operate with software vendors and developers.
- To maintain generic software libraries, e.g. for system components.
- To establish specific software user groups.
- To do inter-model comparisons.
- To define requirements for interoperable software components.
- To promote quality control; e.g. by setting standards for input parameters.
- To discuss the accreditation of software.
- To limit the activities; i.e. to not become over-ambitious.
- Either to engage in strategic alliances with software vendors other than VABI, or to not engage in strategic alliances with commercial organizations at all.
- To make sure that the organization operates independent and has a wider foundation than only ECN, ISSO, TNO, TU/e.

The results for the question **“Such an organization would have to comprise representatives of research institutes, software vendors, policy advisors, educational institutes, etc. Starting point is that independence must be ensured. Do you have any other suggestion about the make-up of such a regional organization?”** can – in no particular order – be summarized as follows.

- Other construction stakeholder such as building owners, developers, architects, construction companies, building services contractors, etc.
- Organizations that are responsible for development and execution of governmental policies, regulation and standardization related to the built environment.
- Start small (expert oriented) and include others later.
- Building system or component manufacturers and suppliers.

The results for the final question **“Apart from board activities, specific tasks can be organised in working groups. Do you want to become active in the board or in a working group?”** can be summarized as follows.

Yes, as member of the board	7 (16%)
Yes, as a member of a working group on:	18 (42%)

Where “a working group on:” was specified – in no particular order - as:

- Software development for building physics and building systems
- User issues and experiences
- Integrated approach of buildings and systems
- Software for the early stages in the design process
- Training and education

- MatLab / Simulink applications
- Optimization of complex building services systems
- System simulation
- Building system control
- Accreditation and quality control
- Renewable energy and sustainable building
- Acoustics

Future plans

Finally a brief outline of future plans. For IBPSA as an international association these can be summarized as follows.

- To increase its membership through expanding and additional affiliate organizations.
- To provide products and services to the global building performance simulation community such as:
 - bi-annual international conference series
 - regular newsletter
 - scientific journal (similar to ISES and Solar Energy)
 - web portal for building performance simulation

Under the existing structure, IBPSA affiliates are financially and administratively independent. In practice, this means that they raise and deploy their funds as long as these funds are under the control of elected officers and are used in pursuit of aims and objectives that are consistent with those of IBPSA. IBPSA-International concentrates its resources on issues such as indicated above. In this way IBPSA complements and empowers the regional affiliates in their attempts to inform and support their members in the context of local design issues and concerns.

The future plans of our regional IBPSA affiliate organization still have to be discussed and decided. The outcomes of the above survey and of the previous symposium (12) show considerable interest and provide many pointers toward possible activities. It is hoped that the current paper and symposium will help in clarifying our aims and objectives and the ways in which we hope to achieve our goals.

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References

- (1) Kusuda, T. (Editor). "Use of Computers for Environmental Engineering Related to Buildings", Proc. of a Symposium sponsored by the National Bureau of Standards, the American Society of Heating, Refrigerating and Air-conditioning Engineers, Inc. and the Automated Procedures for Engineering Consultants, Inc.; held at NBS, Gaithersburg, Maryland, November 30 – December 2 1970.
- (2) Oegema, S. and P. Euser. "An Accurate Computing Method for the Analysis of the Non-steady Thermal Behavior of Office Buildings", in (1), pp. 289 – 304, 1970.
- (3) Boeke, A. and S. Larm. "A System of Computer Programs Widely Used in Europe for Designing, Selecting and Analyzing Different Air Conditioning Systems", in (1), pp. 393 – 404, 1970.
- (4) Clarke, J.A. "Environmental Systems Performance", PhD thesis University of Strathclyde, Glasgow, 1977.
- (5) Bruggen, R.J.A. van der. "Energy consumption for heating and cooling in relation to building design", doctoral dissertation Technische Universiteit Eindhoven, 1978.
- (6) Lammers, J.T.H. "Human factors, energy conservation and design practice", doctoral dissertation Technische Universiteit Eindhoven, 1978.
- (7) Paassen, A.H.C. van. "Indoor climate, outdoor climate and energy consumption: a new approach to the calculation of the effect of the outdoor and indoor climate on the energy consumption in buildings based on methods of statistical analysis", doctoral dissertation Delft University of Technology, 1981.
- (8) Lebrun, J. "Activities for the Building Analysis Group (BAG) for the next semester", <http://www.ulg.ac.be/labothap/ann-bag.htm>, 2000.
- (9) Augenbroe, G.L.M. "BAG_NL activities", in Proc. The Future of Building Energy Modelling, CEC JRC Workshop, Ispra (I), 1987.
- (10) Proceedings 1st Annual Building Energy Simulation Conference, Seattle (WA), August 21-22, 1985.
- (11) Nakahara, N., H. Yoshida, M. Udagawa and J. Hensen (Editors). "Building Simulation '99 in Kyoto". Proceedings of the 6th International IBPSA Conference, 13 – 15 September 1999, Kyoto, International Building Performance Simulation Association, Volumes I, II and III also on CD-ROM. 1999.
- (12) Hogeling, J. W. Plokker and J. Romer (Editors). "Modellen voor Gebouw- en Installatiesimulatie", Proceedings of a symposium organised by ECN, ISSO en TNO-Bouw, Delft, 19 October 1999.