INTERNATIONAL DESIGN CONFERENCE - DESIGN 2004
Dubrovnik, May 18 - 21, 2004.

DESIGN 2004

A CONFERENCE ON ENGINEERING DESIGN IS A COMPLEX PRODUCT

A. Folkeson and U. Sellgren

Keywords: complexity, conference development, concurrent processes, quality assessment

1. Introduction

A scientific journal, a conference and a Web portal are three types of products that to a large extent address the same needs and target the same group of individuals and organisations. If we scrutinise the strengths of each type of product, we find that a journal on engineering design is a suitable form to formally present proven information on the state of the art, best-practices and advances in the field. A Web portal, on the other hand, is more of an informal link to fragmented pieces of ongoing research. A conference, finally, makes it possible for people to meet physically and inspire and challenge each other. Due to space and time constraints, a conference can only handle a limited number of participants. The contributions cannot be as complete as they may be in a journal. The logistics of people, presentations, food and facilities make the process of organising a conference highly complex compared to managing a journal or a portal.

An international conference can be viewed as a complex product, developed for a global market. Consequently, many of the challenges in organising and developing such a product under severe time and cost constraints are similar to those involved in developing a complex technical artefact. These challenges must be addressed in a competitive environment where agility and quality are essential. Agility is the efficient and effective utilisation of internal and external resources to meet changing customer needs quickly and flexibly [Goldman et al. 1995]. It requires a holistic approach. Quality is here used in a broad sense to refer to delivering what the customers (i.e. the conference delegates) need, when they need it.

An engineering design conference must have a highly specialised focus and clear objectives. The following are some common objectives:

- Gather researchers, practitioners and teachers from academia and industry to present and to discuss new ideas, novel approaches and best practices.
- Stimulate the further development of theories, methods and tools.
- Training research students to present and defend their findings.
- Enable researchers from academia and industry to meet and learn from each other.
- Actively support of the enlargement of the academic community.

This paper describes and analyses the experience of developing a recent international conference on engineering design from a product development perspective.

2. Assignment, requirements, organisation and initial work

The *International Conference on Engineering Design* (ICED) is a series of biannual conferences on engineering design that was initiated by *WDK* (Workshop Design-Konstruktion). Since its start in Rome in 1981, the ICED conference series has developed to one of the world's leading conferences on

product development. With ICED 01 in Glasgow, the responsibility and right to continue the ICED conferences was assumed by the Design Society (DS) [Design Society 2003]. In 2000, the DS assigned the realisation of ICED 03 to a conference chairperson at the Royal Institute of Technology (KTH) in Stockholm.

With the aid of the Swedish National Graduate School for Engineering Design (ENDREA), the chairperson formed a consortium of four major Swedish technical universities – the Royal Institute of Technology (KTH), plus the Linköping, Luleå and Chalmers Universities of Technology. A national organising committee, referred to as NatC, was organised. A coordinator was appointed at KTH to assist the conference chairperson. A conference theme was formulated: *Research for practice – Innovation in products, processes and organisations*. Eleven topics were chosen for the conference.

The conference chair coordinated the conference planning in regular meetings with the advisory board of the DS. Approximately 150 reviewers supplied self-evaluations of their levels of competence in the eleven topic areas.

Early in the process, it was decided that the supporting information system should be developed and managed in-house at KTH. One person was assigned responsibility for hardware systems and databases (IS in figure 1) and another for the conference home page, abstract upload and paper reviewing system (Webmaster in figure 1). About one year before the conference, the theme for the conference and eleven topics were published in a call for abstracts. All abstracts had to be uploaded as text at the conference home page [ICED03 2002]. At that time a local programme committee (ProgC), or task force, was organised at KTH. The coordinator was the only member of ProgC who was working 'full time' on conference preparations, although still performing ordinary teaching chores. Figure 1 shows the conference development organisation, with the number of members in each subgroup within parentheses. The 'grand jury' was a working and decision-making group consisting of the six NatC and four ProgC members and two representatives of the DS.

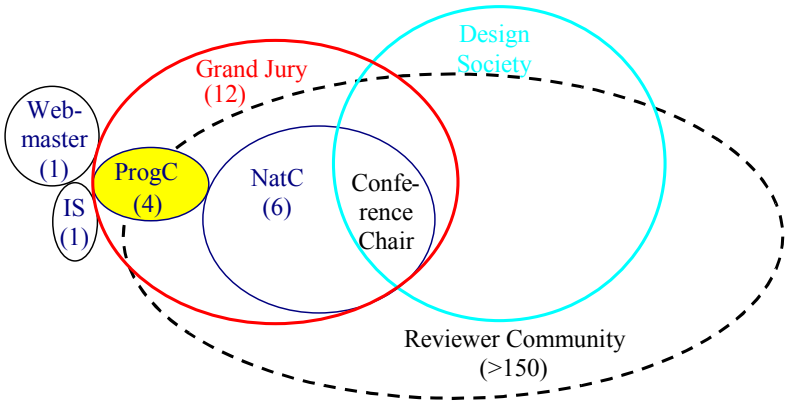

Figure 1. The conference development organisation as interpreted by the authors

3. The conference development process

In the initial requirements it was stated that accepted papers would be presented at parallel *podium*, *panel* and *poster* sessions. A podium session comprises three to four oral presentations. A panel session is basically a focused discussion of a specific topic that starts with a short introduction by each of the four to six panel members. A poster session is focused on face-to-face discussions about approaches and results that are presented on a poster with a limited size.

The ICED conferences have a *tradition* of encouraging researchers from academia and industry to submit extended abstracts on ongoing research for expert evaluation. If accepted, these abstracts are to be developed into high-quality papers for presentation at the conference. The organising committee was requested to adhere to quality standards that are more common for publications in scientific journals than for conferences (e.g. at least three qualified reviewers for each paper). Thus a great deal of time and effort had to be invested, primarily by the ProgC members, in the paper handling and reviewing process.

The *main objective* of a conference paper reviewing process is to find the best concepts (abstracts) and to stimulate the authors to develop them into high-quality components (final papers) that can be aggregated into higher-order functional units or assemblies (conference sessions) to produce a high-quality product (conference). The approach chosen was to divide the paper handling and reviewing process into three consecutive subprocesses, as shown in figure 2.

Abstract handling and reviewing. Each abstract submitted to the conference home page was related to one of the pre-defined topics and was categorised by the author as a research, an industrial or a speculative contribution,. Three reviewers were allocated to each paper. These reviewers were selected on the basis of their nationality and their self-assessed competence on the topic of the actual paper. Where possible, reviewers from three different countries and even from different continents were chosen. The reviewing was blind. On each review form the reviewer assessed his/her level of expertise as either expert, knowledgeable or informed in regard to the specific subject of the reviewed paper. After analysing all reviews related to each abstract, a review synthesis was made.

1. *Full paper handling and reviewing*. Three reviewers (preferably the same as for the original abstract) were allocated to each paper. This review was also blind
2. *Best paper selection*. An initial set of fifty-three candidates was chosen on the basis of reviewers' recommendations on the review form. Two rounds of best paper reviewing by NatC members reduced the number of candidates, first to sixteen and finally to six. During the conference, the NatC and representatives of the DS selected the three best papers from the six candidates.

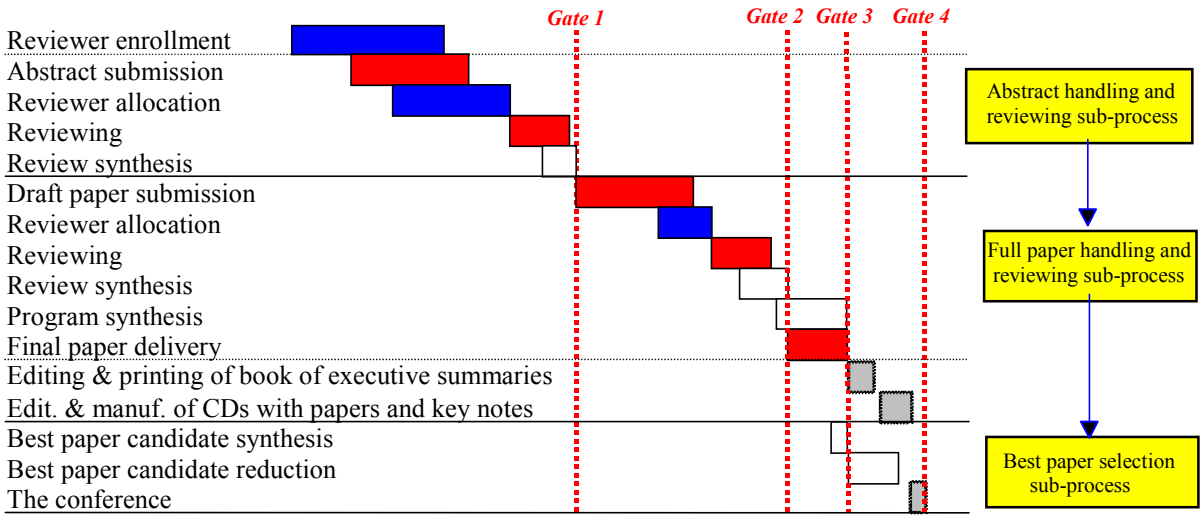

Figure 2. The paper handling and reviewing process

The main tasks in the three subprocesses and the four main decision gates are shown in figure 2. At the two-day gate 1 meeting, each abstract was accepted or rejected by the grand jury. At gate 2, the grand jury rejected or unconditionally/conditionally accepted each full paper submitted. The accepted papers formed the basis for a preliminary conference programme (the sessions). The final status of each conditionally accepted paper (i.e. accepted or rejected) and the final conference programme were decided by ProgC and the conference chair at gate 3. At gate 4, during the conference, the three best papers were finally selected from the reduced set of best paper candidates.

For the abstract and full paper decision meetings (i.e. gate 1 and gate 2), each contribution was labelled and grouped according to the highest and lowest 'bottom-line score' given to it by the reviewers in the review forms. The four bottom-line scores were *accept as is*, *accept with minor modifications*, *accept with major modifications* and *reject*. Thus, for example, one group of contributions was labelled 'accept as is – accept as is', reflecting the views of different reviewers, another was labelled 'accept as is – reject', and another was labelled as 'reject – reject'. This classification scheme made decision meetings more focused and efficient. At both gate 1 and gate 2,

all author names and affiliations, as well as the identity of the reviewers, were hidden from the members of the grand jury.
To allow for just-in-time delivery of abstracts, papers and review forms, all paper uploading and downloading in the review process were Web-based. Information push was used for 'lightweight' information such as a reviewing task, and information pull was used for larger information objects such as PDF files. To enable this procedure, the reviewing process was modelled as an IDEF0 or SADT [Ross 1977] graph-based representation and as a classical GANTT-chart. These two representations are basically complementary. Figure 3 shows an IDEF0 representation of a ProgC view of the review process between decision gates 2 and 3.

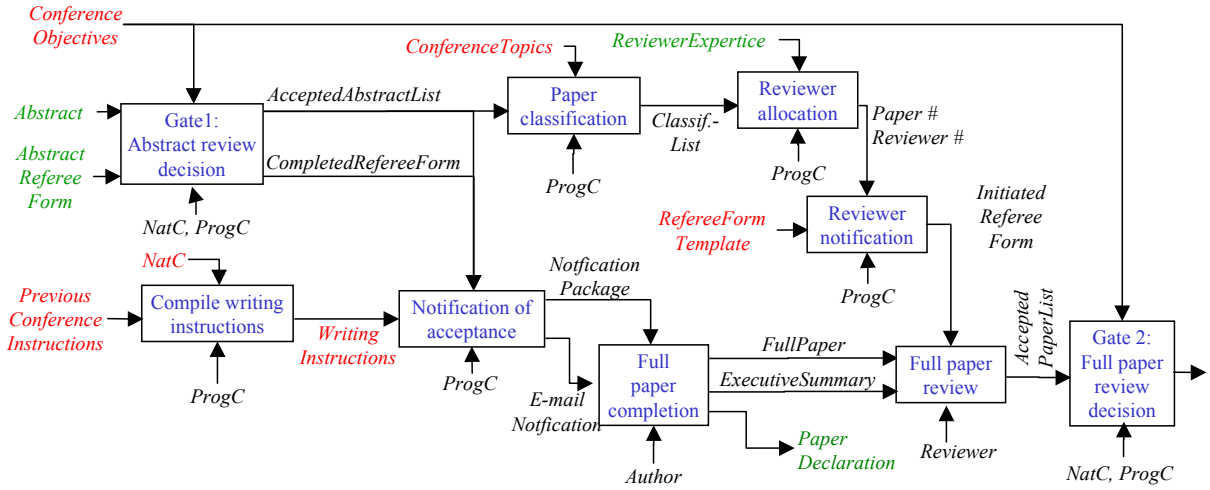

Figure 3. IDEF0 representation of the reviewing process between gates 1 and 2

Podium and panel sessions require spacious premises equipped with audio-visual tools. Given the available facilities and the desire to locate podium and panel sessions in the same vicinity, it was early decided to have four podium and two panel sessions and a poster exhibition running in parallel. It was also decided early that the quality of a paper should not determine the mode of presentation (i.e. podium, panel or poster). All accepted papers were considered equal and the decision on the mode of presentation for each paper was made by the grand jury in the context of the overall programme.
Decisions about the actual configuration of the podium and panel sessions were made by working groups that convened on the second day of the gate 2 meeting. The eleven topics were divided among four working groups, each consisting of three people with a high level of expertise on the topic(s). All of the participants had taken part in the previous day's discussions and decisions on whether to accept or reject each of the uploaded papers. On the morning of the second day, each working group configured the accepted papers in 'their' topic(s) into session candidates. For example, a group of papers on computer-based sketching were brought together under the topic of product modelling and analysis. The members of each working group then scrutinised the configurations proposed by the other groups, and there was a relatively short period of negotiation and trading of papers. With the aid of sticky notes and a large whiteboard, a draft programme configuration was then created. After a few iterations, consensus was reached at the end of gate 2 and a draft programme was approved by the grand jury.
Some slight adjustments were made to this programme in the week following the meeting because of such things as a contribution being withdrawn or the author of a podium paper preferring to present a poster. Some logistic problems were also identified and corrected. Once the final contributions had been accepted, a conference programme was set up and chairpersons recruited. After discussions with previous organisers, the ICED 03 team decided not to have poster chairmen or a best poster award. The recruiting of keynote speakers had started at an early stage.

4. Results and experiences

4.1 The reviewing process

The paper selection process may have been influenced by the fact that the distribution of reviewers did not reflect the nationalities of the authors. Countries like Brazil and France were clearly underrepresented among the reviewers.

Of the 737 unique abstracts that were initially submitted, 483 were accepted and 386 full papers were finally delivered. There were then 1013 reviews of the full papers and 340 papers were finally accepted for presentation at the conference and inclusion in the proceedings. With the aid of the Web-based information system, the organising committee managed to handle just-in-time delivery of papers and reviews. However, the paper upload and the management of the review process required significantly more effort than expected. Authors and reviewers may be regarded as members of a loosely coupled and globally distributed virtual organisation with sporadic communication of very simple information objects. For that reason, the user interface and the instructions to the authors and reviewers on how to use Web-based tools can never be too simple. About 10% of the authors and reviewers caused about 90% of the problems, defined as critical situations that required manual intervention in the reviewing process. The majority of these problems were caused by ambiguous or unclear instructions to the users of the upload and download tools for abstracts, papers and review forms.

The decision to group the papers according to their highest and lowest bottom-line scores had a very positive effect in focusing attention on the key issues at the review decision meetings at gates 1 and 2. For example, there was no need to debate a contribution that had received 'accept as is' as its lowest score. Attention could be focused on contributions with mid-range scores (e.g. 'accept with minor modifications', 'accept with major modifications') and contributions with divergent reviews, (e.g. 'accept as is' – 'reject'). The self-assessment information supplied on each review form was very helpful in promoting efficient assessment of problematic papers with divergent and mid-range scores. The ambiguity of the term 'quality' meant that about a quarter of the contributions received divergent reviews in which one self-reported expert recommended that a paper be accepted while another recommended that it be rejected.

Analysis of the results obtained by using this review process enables us to identify enabling factors and barriers to managing an effective (doing the right things) and efficient (doing the things right) process. The effectiveness of the reviewing process must be judged in relation to the objectives of the conference. These objectives are not distinct and unambiguous, but we may conclude that:

- Abstracts dealing with innovation, industrial design, systems design and creativity had a significantly higher rejection rate than abstracts dealing with design theories, research methods and engineering management.
- Very few contributions from industry were accepted.
- The ten 'most successful' countries submitted 568 abstracts, of which 382 were finally accepted.
- The ten 'least successful' countries submitted 21 abstracts, of which 5 were finally accepted.
- The five 'least successful' countries submitted 11 abstracts, of which 0 was accepted.

4.2 The conference

The evaluation forms submitted by participants at the end of the ICED03 [2003] conference revealed five dominant *personal objectives* for attending the conference:

- Getting an update on the state of the art.
- Getting new inputs and ideas.
- Presenting their own work and receiving feedback.
- Meeting people and making new contacts (i.e. networking).

Conference performance can be defined as how well a conference fulfils its objectives. However, these objectives are rather abstract and general. They are interpreted differently and weighted

differently by different persons and groups, that is, by different stakeholders. Performance is thus a multidimensional parameter. The delegates' response to the question *'Did this conference meet your objectives in attending this conference?'* is only one measure of the success of the conference from a delegate's viewpoint. The three alternatives, *Yes*, *Partially*, and *No,* comprised 86.2%, 7.7% and 6.2% of the answers, respectively.
Scrutiny of the evaluation forms revealed the following opinions:

- With few exceptions, the podium presentations went well and the chairpersons as well as the presenters did an excellent job.
- There were problems with the panels. Some presenters regretted being unable to present their complete work, while others complained of failure to abstract a few important questions that could promote good discussion. Only five of the panel chairpersons actually delivered the requested report for publication on the ICED03 home page.
- Many poster presenters felt snubbed. Some universities refuse to fund an author to attend an 'overseas' conference in order to present a poster. (It is worth noting that the initial set of best paper candidates included 12 poster papers.) Some poster authors reported that they had received no or very little feedback. Several delegates considered the location of the poster exhibition too remote.

5. Conclusions, discussion and recommendations

The organisation of an international conference on engineering design has striking similarities to the development of technical products. Organising such a conference is a complex problem-solving process, which is further complicated by a tight time schedule, a large number of authors and reviewers who are active in the process, and the just-in-time character of their deliveries. Furthermore, organising a conference is a 'once in a lifetime' experience for most people, meaning that the organisers are inexperienced, and most have to simultaneously carry out their normal daily duties. As a consequence, there are few standard procedures in place to cope with various circumstances that arise. A high degree of *flexibility* and a task-force organisation that is both capable of 'coping with different types of critical situations' [Babke-Schaub 1999] and also has the *authority* to do so are highly desirable.
Models are very important tools in performing complex cognitive activities. Checklists, IDEF0-based process models and GANTT charts are complementary tools that significantly reduce the complexity of the conference definition process.
A major problem in the paper review process is adequately defining what constitutes a 'good' abstract and a 'high quality' paper. 'Quality' is an ambiguous term, and several factors contribute to an assessment of the quality of a paper. These factors include the following:

- The context, which in the presented case is engineering design.
- The scope, which is defined by the theme and topics of the conference.
- The relation to the state of the art.
- The innovativeness of the presented approach.
- The clarity of the presentation.
- The written style, which here is equivalent to conformity to the rules and style of the English language.

These factors are very different in character and some are even contradictory. For example, innovative thinking may be so far ahead of the state of the art that it may be regarded as unproven or unscientific. Reviewing of the many contributions to a conference on engineering design must inevitably be subjective to at least some degree.
Another complicating issue is how to enable researchers from the 'not so successful' countries to become part of the engineering design community. The General Guidelines issued by the DS [2001] state that *'some political flexibility should be allowed in the review procedure. New contributors to the conference and contributors from countries with economic or social difficulties should be treated more leniently'.* This directive creates severe problems in relation to both ethics and quality when it comes to applying it in a real process with real people. Who makes the decision as to who should be

treated leniently? How is this compatible with the principle of blind reviewing? At ICED 03 all reviewing was strictly blind.

5.1 Recommendations

The experience obtained by those organising the ICED 03 conference should be summarised as recommendations to the DS as well as to future organisers of similar conferences.

5.1.1 Recommendations for the DS

The DS is chief responsible for the ICED conferences. It has requested that the series of ICED conferences should have a consistent format, and thus documentation from the previous ICED conference in 2001 was made available to the organisers of ICED 03. All relevant documentation from ICED 03 has also been submitted to the DS. We recommend that the DS organise this material as a database that should be accessible to future organisers.
Examples of items suitable for inclusion in such a database include the following:

- Policy documents such as the 'International Conference of Engineering Design, General Guidelines'.
- Logotypes and policies governing their use.
- Letters of invitation and certificates of attendance, including policies governing their use.
- Marketing documents such as calls for papers and brochures from previous conferences.
- Conference programmes and delegate lists from previous conferences.
- Lists of DS members, previous members of advisory boards, chairpersons and others who should be invited to attend.

The evaluation forms used in reviewing abstracts and final papers are crucial to the quality of the conference contributions. The DS must carefully clarify and revise these documents. The forms should be made public so that authors are aware of the requirements before they make a submission.

5.1.2 Recommendations for future organisers

- Clearly define the role, responsibility and authority of each group/person involved in the process.
- Emphasise early recruiting of reviewers and involve reviewers from more countries.
- Provide good instructions for reviewers – and communicate these to the authors.
- Encourage more assisting reviewing of contributions from less established countries and authors.
- Set up a good Internet technology system. This communication system should be organised and tested early. Reviewers and authors should be given instructions on how to use it. The password system should be as simple and unambiguous as possible.
- Have reviewers and authors/presenters submit/upload their contributions to a database run by the organisers. Once again, clear instructions to all about the password system are needed.
- Simplify the paper acceptance decision process by adopting a classification scheme based on the highest and lowest bottom-line review rankings of the contributions.
- Communicate podium instructions to chairpersons and presenters in advance.
- Choose contributions, chairpersons and presenters for a panel sessions carefully. They need to be well-informed about the presentation form and well-prepared. The role of the chairperson is crucial and only very experienced persons should be chosen as chairs.

Acknowledgements

The authors want to thank the DS representatives, Alex Duffy and Mogens Myrup Andreasen; the chairperson and members of the NatC, Margareta Norell, Sören Andersson, Hans Johannesson, Lennart Karlsson, Johan Malmqvist and Jan-Ove Palmberg; as well as the colleagues on the ProgC, Kjell Andersson and Klas Gralén, for a most interesting and inspiring journey.

References

Badke-Schaub P. and Frankenberger E., 'Analysis of design projects', Design Studies, 20, 1999, pp 465–480.
ICED03, 'Participants' Evaluation of ICED 03'. The Design Society, 2003.
Design Society, 'The Design Society', http://www.designsociety.org, 2003.
Design Society, 'International Conference of Engineering Design. General Guidelines', annexe A to Agreement. The Design Society, 2001.
Goldman, S.L., Nagel, R.N. and Preiss, K., Agile Competitors and Virtual Organization, Van Nostrand Reinhold, New York, 1995.
ICED03, 'Conference home page', http://www.iced03.conf.kth.se, 2002.
Ross, D.T., 1977, 'Structured analysis (SA): A language for communicating ideas', IEEE Transactions on Software Engineering, Vol. SE-3, No. 1, 1977, pp.16–34.

Anders Folkeson and Ulf Sellgren
Royal Institute of Technology (KTH), Department of Machine Design, SE-100 44 Stockholm, Sweden
Telephone: +46 - 8 790 73 87, Telefax: +46 - 8- 723 17 30
E-mail: ulfs@md.kth.se